RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

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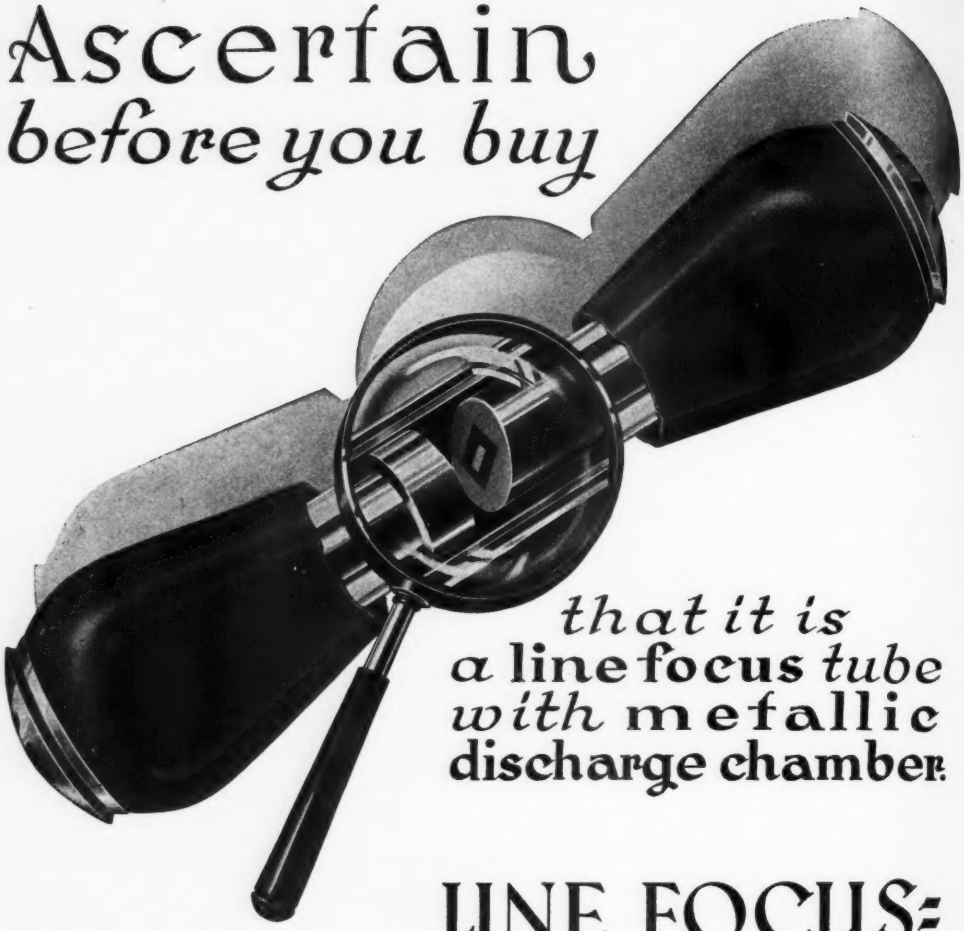

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LINE FOCUS=
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RADIOGRAPHIC QUALITY
and ECONOMY

C. H. F. MÜLLER A.-G.

HAMBURG - FUHLSBÜTTEL, RÖNTGENSTRASSE

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RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

VOL. XIX AUGUST, 1932 No. 2

UNDESCENDED SCAPULA WITH AN OMOVERTEBRAL BONE[1]

By BYRON H. JACKSON, M.D., SCRANTON, PENNSYLVANIA

THE subject of this article is an intelligent, male Porto Rican, 23 years of age, who was admitted to the Moses Taylor Hospital, Scranton, Pennsylvania, with an abscess of the left subclavicular region. No cause for it was found.

An X-ray examination of this and the adjacent area showed a left omovertebral bone (Fig. 1). Figures 2, 3 and 4 show the deformity of the left shoulder, the short, thick neck, and the inability completely to elevate the left arm. The deformity of the left shoulder and neck and the restricted motion of the left arm are due to an omovertebral bone which connects the upper half of the vertebral border of the left scapula to the cervical spine.

The attachment of the omovertebral bone to the scapula is cartilaginous, as there is a definite space, the same width throughout, which does not change upon motion. The superior border of the scapula is bent forward. This forward bending of the superior border of the scapula was shown on roentgenograms made stereoscopically, although the film here reproduced does not show this deformity.

DESCRIPTION OF THE ROENTGENOGRAM

The left scapula is 2 inches higher than the right. It is 5.75 inches in its widest extent from the margin of the glenoid cavity to the vertebral border, and 7 inches long, being 1.5 inches wider, and 0.5 inch longer than the normal right scapula.

This left scapula represents four borders: axillary, superior, vertebral, and oblique, differing from the normal, therefore, in having an oblique border. This border, which extends from the vertebral to the superior border, is 3.75 inches long, occupies the position of the normal superior vertebral angle, and presents a double curve. The vertebral border, therefore, is only 4.5 inches long as compared to 5.5 inches for the normal vertebral border of the right scapula, and is curved with the concavity toward the spine. Attached to the lower half of the oblique border is a triangular bridge of bone 2 inches wide at its base and 3.5 inches long, extending upward to the fifth cervical vertebra. There is a definite space between it and the scapula, which appears like a joint. The superior border of the left scapula is bent forward to form a shelf. The anterior margin of this shelf bends forward and downward so that its outer two-thirds is actually below the spine of the scapula. The first rib on the left side is smaller than on the right. The cervical spine appears to be normal.

The figures here given are from a roentgenogram made at a target film distance of 25 inches, and do not, therefore, represent

[1]Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

Fig. 1. Author's case, showing the omovertebral bone passing from the cervical spine to the left scapula.

the actual measurements. Figure 5 is a tracing from the roentgenogram.

EXAMINATION AND HISTORY OF PATIENT

The patient states that there has been no similar deformity in his family or, so far as he knows, among his ancestors. His mother, who did not discover the deformity until he began to walk, knew of no cause for its appearance, such as injury, etc. The patient is a well developed, muscular, healthy appearing young adult. When he is standing erect and viewed from the front, the whole left chest is seen to be higher than the right; the left nipple, the folds of the skin, the entire clavicle, and the shoulder are higher on the left than on the right side. The upper border of the left scapula is 2.5 inches higher than the left clavicle. The lower half of the neck is much wider on the left. The left shoulder and outer end of the left clavicle are thrown forward so that their plane is 1 inch in front of the right.

Viewed from the rear, the lower angle of the left scapula is 3.5 inches higher than the right. The vertebral border is not straight but presents a double curve like a flattened "S." There is a dorsal scoliosis with the convexity to the right. Projecting upward from the superior border of the left scapula, and apparently attached to it, is a hard bony mass, triangular in shape. Its base is fixed at the scapula; its apex to the third or fourth cervical spine. It lies immediately under the skin and its posterior surface is irregularly nodular. It is curved forward from below, giving the patient the appearance of a "round shoulder." This triangular bony bridge which is 5 inches long from base to apex, the base being 2 inches wide, is firmly fixed to the spine and scapula. The superior border of the left scapula bends forward, so that the fingers pass under a shelf of bone. The supra- and infraspinatus muscles of the left side are less developed than the right. The left sternocleidomastoid muscle is thick, appearing to be twice the size of the corresponding muscle of the right side. The muscles of the left chest, arm, and shoulder seem to be normal, though less developed than the right. There is no restriction of motion in the left arm, except in the shoulder. The patient is unable to elevate the left arm above the horizontal without bending the neck to the opposite side; even then there is very little elevation above the horizontal. The patient states he is not conscious of this restriction. He is able to perform without difficulty all his duties, which are those of an anthracite coal miner. He says that, when he was a boy, he was not handicapped at play, never being conscious of the deformity or restricted motion.

REVIEW OF LITERATURE

"This condition, both on account of its rarity, and because of its puzzling etiology, has been a source of interest for fifty years" (81).

This affection was first described by Eulenburg (1) in 1862, and again (2) in 1863. Each time he believed that he was dealing with an exostosis of the scapula, arising from a periostitis due to injury.

In 1891, Sprengel (6) reported four cases, which he thought were dislocations of the shoulder, suggesting that they might occur during intra-uterine life, due to a deficiency of amniotic fluid. Since his pub-

Fig. 2. Author's case. The position at rest.

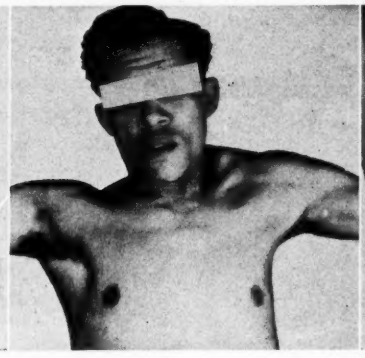


Fig. 3. The same, showing extent of active abduction.

Fig. 4. The same, comparing the abduction on each side.

lished report, this has been known as "Sprengel's deformity," "an objectionable term, because meaningless to the uninitiated, and requiring an effort of memory for its recollection, and as shedding on Sprengel a luster to which he is scarcely entitled" (74). Furthermore, this single term neither takes into account the various types of the deformity nor the factors entering into their production.

This condition is often spoken of as "congenital elevation of the scapula," or "congenital high scapula." "Congenital elevation of the scapula" is incorrect since, "The high position is not due to elevation, but failure of descent; possibly a better term would be 'undescended scapula.' Another instance in terminology is the 'undescended testicle,' which we do not speak of as 'congenitally elevated'" (81).

EMBRYOLOGY

A consideration of the embryology of the scapula, as given by Keith, will enlighten us as to its high position. "Undescended scapula" is the correct term since, "The arm of the human embryo is cervical in position. It descends during the second month. Its descent is not only accompanied by an elongation of the brachial nerves, but also by a downward migration of certain muscles originally placed in the neck, trapezius, serratus magnus, latissimus dorsi, and pectoral muscles. The descent may be arrested. The condition, which is not rare in children, is often accompanied by irregularities in the formation of the cervical vertebræ, for the elongation of the cervical region to form a neck is related to the descent of the shoulder, of the heart, and of the diaphragm" (99).

From a consideration of the embryology it will be seen that probably no single term for this affection will be adequate, but, in the light of our present knowledge, the condition should be known as undescended scapula.

DEFINITION

Undescended scapula is the congenital condition characterized by a unilateral or bilateral high scapula which produces a thick, short neck with a corresponding high shoulder, having its supra-spinous portion bent forward. There is usually inability to elevate the arm of the affected side above the horizontal, without bending the neck and the body to the opposite side. It is always accompanied by other defects or anomalies, either singly or in combination, as follows:

1. Defects of the cervical spine with, or without, an omovertebral bone.

2. Defects of the muscles with, or without, bony defects.

3. An omovertebral bone without defects of the cervical spine.

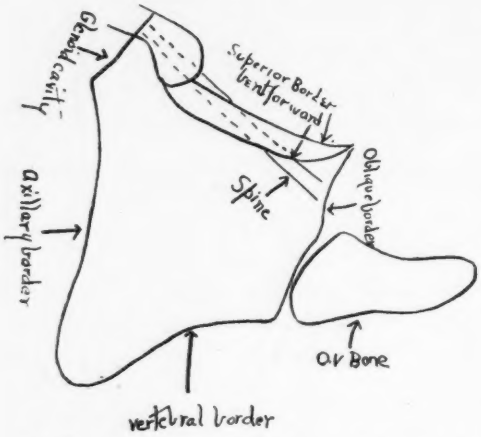


Fig. 5. Author's case. Diagram of changes in scapular borders.

The forward bending of the supra-spinous portion of the scapula is common to all types of undescended scapula. It is due to the molding effect of muscles described by Meyer (109). If during development the scapula is retained in its original embryonic position, its shape must conform to the surrounding pressure, consequently the supra-spinous portion is rolled forward to conform to the shape of the neck.

CLASSIFICATION

There are at least three types of this deformity, which are given in the order of the frequency of their occurrence.

1. Undescended scapula, accompanied by defect in the cervical spine, usually spina bifida. An omovertebral bone may, or may not, be present.

2. Undescended scapula, accompanied by defects in the muscles.

3. Undescended scapula, accompanied by a bony bridge connecting the scapula to the cervical spine, with no spinal defects.

Some change in the muscles is found in every type, for it is quite evident that the abnormal position of the scapula must, of necessity, produce distortion of the muscles; but here the position of the scapula is the cause of the muscular change, and not the result of it.

DISCUSSION OF THE THREE TYPES

Type 1.—Cohn (59), Kienböck (67), and Maffei (102) found spinal defects in every case of undescended scapula. They believed that this affection was always accompanied by spinal defects. Many other writers report cases of bifurcated cervical spines having an omovertebral bone attached to the scapula, which, Keith has shown, lies in close contact with the cervical spine during early intra-uterine life.

The literature contains but two autopsy reports of undescended scapula, both of which illustrate Type 1. The first was made in 1880 by Willett and Walsham (3), who gave an account of dissecting the body of a woman, the subject of congenital malformation of the spinal column, bony thorax, and left scapula. Since the cervical spine was bifurcated, this case belongs to Type 1.

They say: "The left scapula represents a remarkable deformity. There is a broad bridge of bone extending from the middle third of the posterior border of the scapula backward and upward to the lamina and spinous processes of the sixth cervical vertebra. The bridge-like portion of bone connecting the scapula to the spine is of an irregular, triangular shape; its base, which looks outward, being ankylosed to the posterior border of the scapula; its apex, which looks inward, to the spinous processes of the sixth cervical vertebra. Its base is fused with the scapula except in its upper third, where it is connected only by a soft tissue, and at a spot in its lower third where a

foramen is left sufficiently large to admit a pea. Anteriorly, however, there is a small sulcus filled with cartilage in the recent state which exists between the bone and the scapula. There is also a left cervical rib attached to the seventh cervical vertebra, and united to the first thoracic rib. The spinous process of the sixth cervical vertebra is cleft, the left half and left lamina being fused with the triangular bridge of bone." (Fig. 6.)

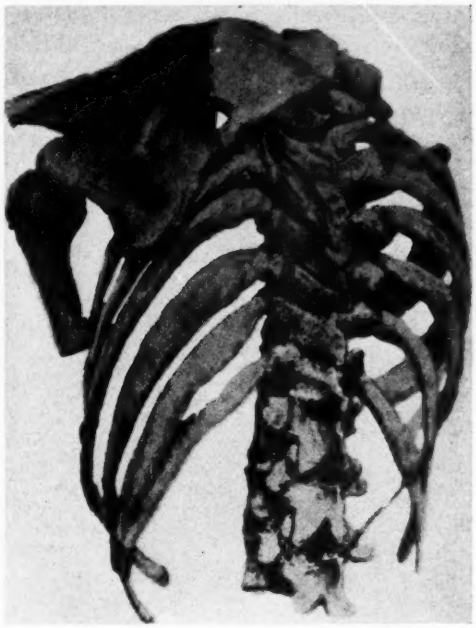


Fig. 6. Reproduced from Willett and Walsham (3).

The second autopsy was reported in 1914 by Fetterolf and Arnett (81), whose "article was written to put on record a case in which a complete autopsy was obtainable. The condition was found to exist in a body in the anatomic laboratory of the University of Pennsylvania. The subject was a male negro about 40 years of age, of medium size and good muscular and general development.

"The scapula differed from most of the cases hitherto reported in that, with the exception of the scapular index, it was approximately normal in size and showed pronounced roughenings for the attachment of strong muscles. On the vertebral border, just below the spine, was a triangular facet which faced forward and inward, articulating with a bony projection from the sixth cervical vertebra. The scapula articulated with an exostosis, which caused the lump felt on external examination, from the sixth cervical vertebra, the articulation being partly responsible for the restricted upward movement of the arm. This osseous growth consisted of a strong, markedly curved process of bone about 4 cm. in length, which arose from the right lamina of the sixth cervical vertebra. Viewed from the left, it was seen to be roughly triangular, the apex being attached to the lamina, the base being free and directed well toward the right. Both the pedicle and the lamina of the right side of the vertebra were much thickened. . . . A noteworthy point in regard to the vertebræ was that the right laminæ of the fifth and seventh, as well as the sixth cervical vertebra, had not joined those of the left side to complete the arch; a condition of spina bifida was present in these three bones." (Fig. 7.)

This case is also Type 1. In the first case, the lower attachment was partly bony, having cartilage lying in a sulcus. In the second case, the attachment resembled a true joint. It is quite evident from the above autopsy reports and the accompanying reproduction that the omovertebral bones were formed from a vertebra, and not from the scapula.

In these cases, I believe the rudimentary rib, which ordinarily is represented by a small process—the anterior root of the transverse process of a cervical vertebra, known as the costal process—develops into a large bone, becoming a real cervical rib. This cervical rib has articulated with the

scapula; hence it forms what is known clinically as the omovertebral bone.

Type 2.—We have seen that the normal descent of the scapula may be prevented by muscular defects which are of such a

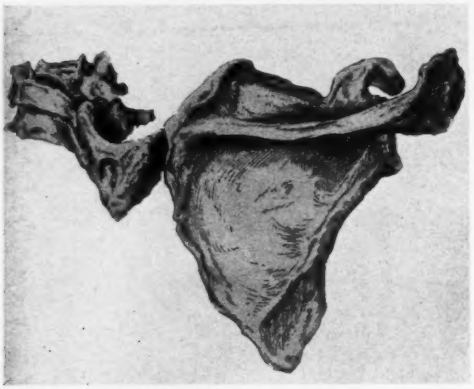


Fig. 7. Reproduced from Fetterolf and Arnett (81).

nature that the scapula, during development, cannot migrate. The scapula may not receive the unusual downward muscular pull, as in cases in which the pectoral muscles and breast are absent, etc., or it may be retained by shortened muscles or fibrous tissue.

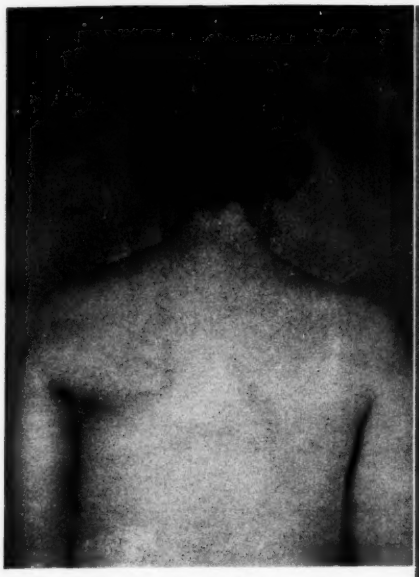
These cases may have all types of muscular defects accompanied by absence of the breast (74). Frequently there are webbed fingers or absence of one or more fingers, mentioned by Fairbank (73), who says: "I have notes of 15 cases which I have been privileged to examine—all types—some simple elevations; those in which the scapula is anchored to the spine by fibrous tissue, or short muscles, or cartilage; some associated with gross malformations of ribs and spinal column, suppression of one radius and the corresponding thumb. Two cases may appear just alike, yet the roentgenograms will show deformities and deficiencies of other bones in one while the other will show no such condition. To explain these gross errors in development in muscles and bone we must look to the earliest days when the differentiation of the mesoblast is taking place. Errors in the segmentation of the mesoblastic tissue would account for fusion or suppression of the ribs, suppression of one-half a vertebra, or the whole of one or more vertebræ, the muscular abnormalities and the occasional presence of an abnormal bridge of bone between the scapula and the spine, as well as the faulty position and shape of the scapula itself." He adds, "Though this theory leaves us in ignorance of the cause of the embryonic error, it does place the cases on a common foundation."

In this type the descent is prevented by muscular defects entirely. The following appended report will serve to illustrate many marked defects.

History.—R. W. W., male, aged 14 years, was examined at Moses Taylor Hospital, April 9, 1927. The mother says that at birth the cord was wound around the infant's left arm, and she attributes the present condition to this. There are two other children in the same family who are perfectly normal in every way. The mother knows of no similar deformity among the ancestors. The motions in the shoulder and elbow are practically normal, but there is considerable disability in the hand.

Examination.—When the patient is standing in a symmetrical position, there is marked elevation of the left shoulder. The left sternomastoid and trapezius muscles are more prominent, and the angle of the scapula is 2.5 inches higher on the left side than on the right. There is no apparent deformity of the spine. The vertebral border of the left scapula is decidedly more prominent than that of the right, as though there is absence or weakness of the serratus magnus muscle. The sternal portion of the pectoralis major is absent, but the clavicular portion is fairly developed. The pectoralis minor is very atrophic, or absent. Viewed anteriorly, there is the same elevation of the

left shoulder and very marked prominence of the left ribs, due to complete absence of the sternal portion of the pectoralis major. The tip of the ninth rib of the left side, which is more prominent than the right, projects sharply under the skin. On inspection and palpation, the clavicular portion of the pectoralis major is apparently normal. The mammary gland is absent on the left side; the right is normal. There is no evidence of accessory glands. The left sternocleidomastoid stands out more than the right. The entire left arm is slightly less developed than the right and the muscles are smaller and flabby. The circumference over the prominent portion of the biceps of the right arm is 1 inch greater than the left, and there is some diminution in circumference of the left forearm. The left hand is rudimentary, being very much smaller than the right hand, with marked webbing of the fingers. All the proximal phalanges of the left hand seem to be of normal length, but the other two phalanges are much shorter. There is no limitation of motion in the left shoulder and arm. All motions in the elbow and wrist are normal. The deformity in the fingers does not hinder the patient in ordinary life. Roentgenograms are negative, except of the hands (Figs. 8, 9, 10, and 11).



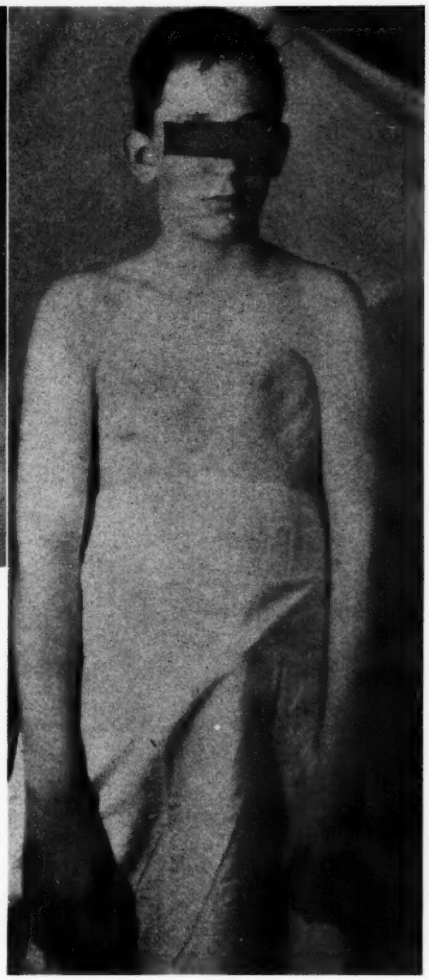


Fig. 8 *(left)*. Position at rest.
Fig. 9 *(right)*. The same position. Note the prominence of ribs from absence of pectoral muscles; also absence of mamma.

Summary.—It is evident that the undescended scapulæ in the autopsy reports of Willett and Walsham (3) and of Fetterolf

and Arnett (81), depend upon a quite different mechanism than the undescended scapula in the above case. In the former (Type 1), there is a spina bifida and a bony bridge of spinal origin. In the latter (Type 2), the spine is normal. There is no extra bone, and the condition is apparently muscular in origin.

Type 3.—Wilson and Rugh (25) gave a complete report of two operations for the removal of omovertebral bones. They say: "The bone removed from the younger girl was one and one-quarter inch long and one and one-eighth inch in circumference. At the spinal end there appeared two small *tuberosities* which, together with the space between them, were covered with *articular cartilage,* as was also the scapula end. These *tuberosities gave the specimen the appearance of the spinous process,* they being the parts which have attachment with the laminæ of the arch."

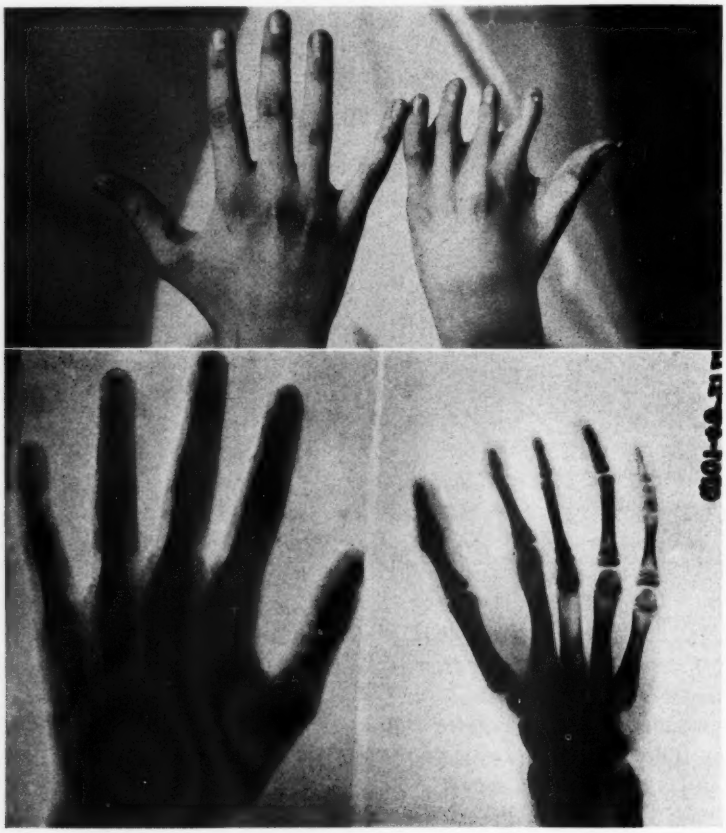


Fig. 10 *(above).* Webbed and deformed fingers on left hand.
Fig. 11 *(below).* The same patient. Roentgenogram showing shortened second and third phalanges.

The above description is not that of the spinous process. A spinous process is *not* connected to the arch by articular or other tuberosities. The above description is that of a *rib* which has a facet by which it is articulated to the bodies of contiguous

vertebræ and a tubercle presenting a facet for articulation with the transverse process of a vertebra.

Kayser (29) reported an omovertebral bone attached to the *sixth* cervical vertebra, which he interpreted as a cervical rib. Mautner and Selka (63) removed an omovertebral bone from a three-months-old infant and found no spinal anomaly. Putti (64) gives a detailed description of an omovertebral bone which was covered by a muscular layer from the central portion of the trapezius, and joined to the scapula by cartilage. "The vertebral end of the bone showed an epiphysary head connected with the diaphysis by a thin upward bent neck. The diaphysis consisted, for the most part, of a spongy substance enclosed in a thin, compact layer. This spongy substance was thickened at the vertebral end. Histologically, the bone resembled a long bone in the stage of development." Putti emphasizes the vertebral origin of the omovertebral bone and adds, "an offspring of the spine, just as a rib."

Jünger (68) reports an omovertebral bone, "having two articular facets at its upper end, with which it articulates to the transverse process of the *sixth* cervical vertebra, and the next [meaning the seventh]. This facet was also analogous to ribs, although their connection with the transverse processes differs in that a rib articulates with the anterior surface of the vertebra, whereas this bony extension was bonily united to the anterior surface of the transverse process."

The attachment described above is exactly analogous to a rib which is attached at its vertebral end to the bodies of contiguous vertebræ, resting upon, and being united to, the transverse process.

Horwitz (65) reported 100 collected cases of undescended scapula. Of these, 67 per cent showed some defects in other parts of the body. Case 5 of his series presented "a triangular shaped prolongation from the scapula ending in a small articular head attached to the transverse process of the vertebra [which one not stated]. In size, shape, and appearance, this prolongation resembled a rib."

Shore (113) removed an omovertebral bone which resembled a small clavicle. It measured $10.5 \times 1.5 \times 1$ centimeters. It was attached above the sixth cervical vertebra.

In describing the operation he says: "An anomalous bone was exposed, and found to articulate with the vertebral border of the scapula. The articular surfaces were covered with cartilage. This attachment was divided, and the bone lifted from its bed. In order to facilitate its removal, the periosteum was divided and stripped, leaving the cortex bare. This procedure was carried out the entire length of the bone to its articulation with the *sixth* cervical vertebra."

The literature contains many reports of omovertebral bones which have been removed, and which have the following characteristics:

1. They are attached to the scapula by cartilage, just as a rib is attached to the sternum.
2. They have articular facets by which they are attached to the cervical spine.
3. They are provided with a tubercle.
4. In composition they resemble ribs.

These descriptions seem to furnish adequate evidence that the omovertebral bone of Type 3 is a true cervical rib, differing chiefly from ordinary cervical ribs in that it attaches itself to the scapula. Therefore, the suggestion that the omovertebral bone of Type 1 is also a cervical rib is very much strengthened, and it would seem that all omovertebral bones are cervical ribs. Cases have been reported in which there was a cervical rib and an omovertebral bone existing simultaneously. In fact, many cases are on record in which an omovertebral bone and a *seventh* cervical rib existed simulta-

neously on the same side, but no cases are reported in which a cervical rib and an omovertebral bone were attached on the same side at the same level.

Liberknecht (57) found a seventh cervical rib with an omovertebral bone attached higher up. In Willett and Walsham's case also, there was a left seventh cervical rib. An omovertebral bone has been found with a fourth, fifth, or sixth cervical rib on the opposite side. The presence of cervical ribs, therefore, has a tendency to strengthen this theory. Furthermore, a cervical rib is attached to the spine by one or two articular facets, and it has a tubercle for articulation with a spinous process. It is also tipped at its free end with costal cartilage, and attaches itself to other ribs where contact is made, as in Willett and Walsham's case, or even to the clavicle.

Morris (112) gives a description of a cervical rib from a dissection. "In one fortunate case Turner was able to make a thorough dissection of a specimen in which a complete cervical rib existed. Its head articulated with the body of the seventh cervical vertebra, and had a stellate ligament. The tubercle was well developed, and articulated with the transverse process. The costal cartilage blended with that of the first thoracic rib, and gave attachment to the costoclavicular ligament." It is fair to presume, therefore, that a cervical rib may attach itself in the same way to the scapula, although the *seventh* cervical rib may not do this because, during intra-uterine life, it projects downward beneath the scapula, and no contact is made. This is illustrated in the cases of Lieberknecht and Willett and Walsham. It does not apply, however, to cervical ribs which arise above the seventh, because they do come in contact with the scapula during the first few months of intra-uterine life.

Rager (27), who believed that the omovertebral bone was costal in origin, dismissed this idea when he found that the vertebral end was attached to the arch instead of to the bodies of contiguous vertebræ. In Kienböck's (67) case, an omovertebral bone was attached to the arch of the fifth cervical vertebra.

We have seen from the embryology that the descent of the scapula is associated with the migration of the muscles. A cervical rib may migrate in the same way, since the muscles are the same during its formative stage.

THEORY OF THE ORIGIN OF OMOVERTEBRAL BONES

That the omovertebral bone is of scapular origin was suggested by Willett and Walsham (3), who based their theory upon their knowledge of a single case. They say: "We have looked through the Hunterian and several other museums, but have failed to find any like deformity. Neither have we come across any specimens resembling it in published records. We know of no exactly homologous condition." Later they reported a similar case (114). Their failure to mention cases other than those of Type 1 presupposes their lack of knowledge of other types. Nevertheless, their theory has been quoted by many authors. Horwitz (65), referring to their articles, says: "This bridge of bone is, in their opinion, an abnormal development of the supra-scapular epiphysis, which normally existed as a narrow ridge of bone along the posterior border of the scapula, and, consequently, as homologous to the supra-scapular bone as some of the lower vertebrates." The frog and the skate are mentioned as those animals which have a supra-scapular bone. Although I have examined the skeleton of a frog, I find there is nothing which resembles in any way this omovertebral bone.

However, none of the authors who accept their theory takes into account the fact that the omovertebral bone is joined to the scap-

ula by cartilage; or, if there is bony union, it is not complete, a small fragment of cartilage being attached. This fact alone would prove that the bone, of whatever type, originates at the spine and not at the scapula. *I know of no bone in the animal kingdom which produces another bone having cartilage intervening.* If this bone is produced from a supra-scapular epiphysis, as some say, it should have a bony union with the scapula; in an adult, all evidence of an epiphyseal origin should have disappeared. On the other hand, bones of costal origin are tipped with cartilage. Their function is to attach themselves to other bones, just as this one does, a cervical rib frequently attaching itself to the clavicle or to the first rib.

When the embryology is considered, the origin of the omovertebral bones presents no difficulty. The puzzling question is, What produces muscular defects, spina bifida, or cervical ribs? The failure of the scapula to descend depends upon one or more of these conditions.

Those who object to the theory that the omovertebral bone is costal in origin, and is a cervical rib, say that its base is too wide and the entire bone too heavy. These objections disappear when we remember that the scapula lies opposite the cervical vertebra during the first three months of intra-uterine life, and that the base of this triangular bridge is probably formed, not by the tip of the rib, but by this inferior margin which crosses the scapula at its superior vertebral angle. Later it is pulled upon by many strong muscles which not only bend the rib down, but have a tendency to increase its thickness and width. The shape and size of a bone is determined partly by the muscular force which it must withstand.

This paper is not written to discuss the cause of defects and anomalies, but to assert that an omovertebral bone is formed of a costal element, which comes in contact with the scapula during the first few months of intra-uterine life, and that it is in reality a cervical rib arising above the seventh.

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TUMORS OF THE DUODENUM AND HYPERTROPHIED GASTRIC MUCOSA PROLAPSING THROUGH THE PYLORIC CANAL INTO THE DUODENUM

CASE REPORTS, WITH A REVIEW OF THE LITERATURE

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TUMORS of the duodenum and benign gastric hyperplasias prolapsing through the pyloric canal into the duodenum occur with such relative infrequency as to justify detailed reports of cases as they occur. The diagnosis is difficult and treatment is often misdirected. Though rare, these conditions have been established as clinical entities and they should receive reasonable consideration in the diagnosis of gastric complaints.

The purpose of this paper is to review the literature and to place on record the roentgenologic findings in two unusual cases, one, a sarcoma of the duodenum, metastatic from an identical lesion on the thigh, the other, a hypertrophy of the gastric mucosa, lengthened out in the form of a polypoid mass which at times prolapsed into the duodenum.

CASE REPORTS

Case 1. A colored woman, aged 48 years, was admitted to St. Philip Hospital on July 10, 1931. Her chief complaint was of a mass on the right thigh near the hip and "stomach trouble."

The mass on the thigh, which she had first noticed in 1912, began as "small knots" under the skin. These were removed in 1918; but recurrence ensued and the mass had reached considerable size when it was removed again in 1926. Similar recurrences were removed in 1929 and in January, 1931, but there was again a prompt return. In July, 1931, the mass was as large as a small coconut.

The abdominal distress began three months prior to admission. The pain, gradual in onset, was of a dull aching character. There was a constant sensation of gastric fullness; vomiting occurred frequently, especially after eating heavy foods. No blood had ever been noted in the vomitus. Soft and liquid diets could be tolerated. The pain had occurred intermittently from its onset and had grown more severe and more frequent one month prior to admission. At this time the attacks were occurring in frequent colicky paroxysms lasting from 20 to 30 minutes. During the paroxysms, a swelling formed in the upper abdomen, disappearing after the pain had subsided. The woman was not relieved by food, but was occasionally relieved by changing her position and by vomiting. She had lost 40 pounds in weight.

Physical Findings.—Severe emaciation, anemia, a slight adenopathy of the cervical and inguinal glands, an elusive palpable mass in the right upper quadrant felt at times when the patient lay on her left side, and a multilobular, insensitive mass, about the size of an adult fist, on the external aspect of the right thigh near the hip, infiltrating the surrounding tissues.

Laboratory Examination. — The blood showed the usual findings of secondary anemia; hemoglobin, 30 (Sahli); Wassermann, negative.

Other examinations were negative.

The woman was operated upon for the removal of the tumor on the right thigh. The pathologic report was relatively nonmalignant fibrosarcoma.

A few days after the removal of the mass

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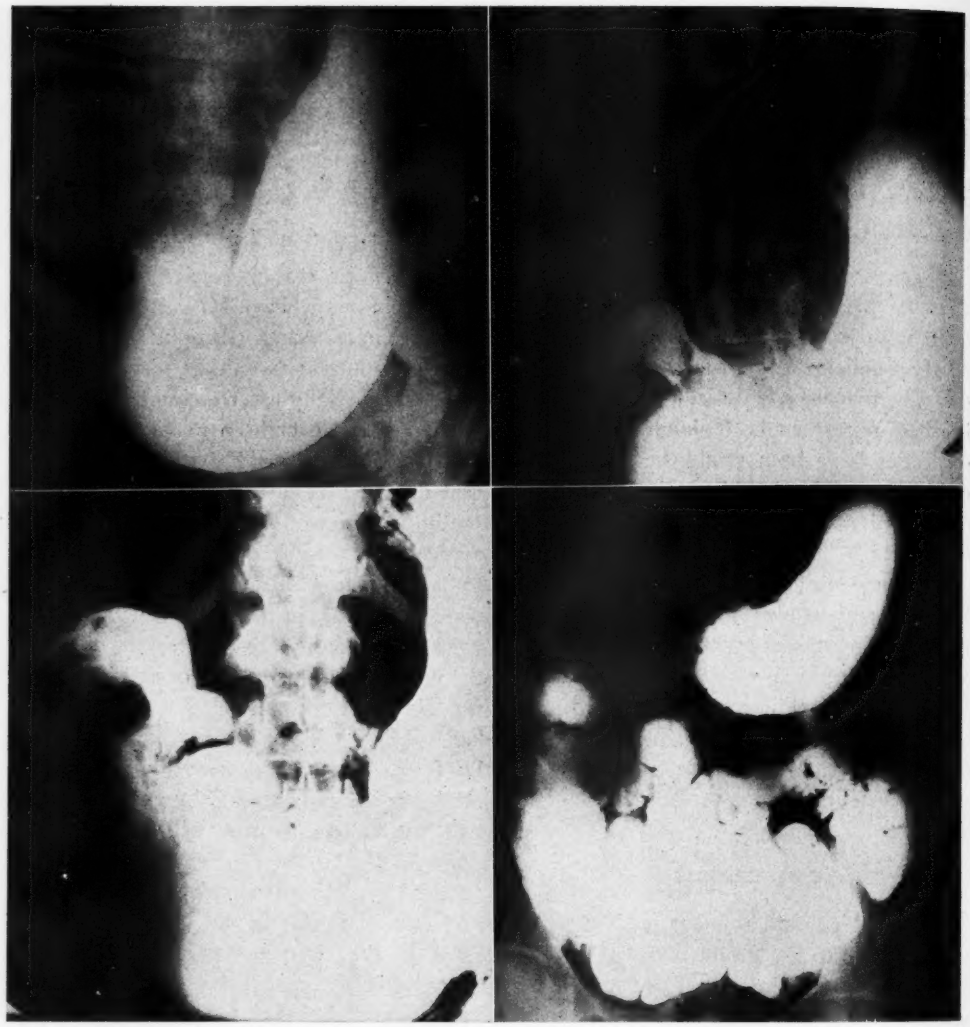

Fig. 1 *(upper left)*. Case 1. Dilated and atonic stomach with peristalsis absent. The duodenal bulb is faintly shadowed. Film made in the erect position.

Fig. 2 *(upper right)*. Case 1. Filling defect with trabeculation. Note the preservation of the periphery of the duodenal cap. Film made in the prone position.

Fig. 3 *(lower left)*. Case 1. Multilocular filling defect in dilated duodenal bulb. Note the faint outline of the periphery of the bulb. No explanation for the diverticulum-like deformity on the lesser curvature was found at operation.

Fig. 4 *(lower right)*. Case 1. Six-hour gastric residue.

the patient was admitted to the X-ray Department for gastro-intestinal study. X-ray examination showed a considerably dilated and atonic stomach with a large six-hour residue. The duodenal bulb was markedly dilated. In the erect position, it could not be filled completely and a large, central, translucent filling defect, with the periphery faintly outlined by a thin shell of the opaque mixture, was seen. The cap, which did not fill completely in the prone position, showed a large constant filling defect that was at

times irregularly circular, or oval, at other times, multilocular. The deformity was translucent, always outlined by a thin barium shell, and traversed by trabeculations. The defect was demonstrated in the erect, and the right oblique prone, and supine positions. There was no evidence of duodenal constriction. The impression from the examination was that the filling defect was produced by extrinsic pathology, probably a tumor in the region of the pancreas, or aberrant pancreatic tissue in the region of the duodenum. The possibility of a duodenal tumor was considered, but, because of the rarity of the condition, it was dismissed as improbable. The abdominal operation was performed 10 days after the removal of the tumor.

The stomach was greatly dilated, the first four inches of the duodenum was at least three times its normal size, being approximately 2.5 or 3 in. in diameter. A hard tumor about the size of a hen egg was felt within the lumen of the duodenum. There were no adhesions or evidence of liver, gallbladder, or other abdominal disease, and it was decided to remove the pyloric portion of the stomach and the first three inches of the duodenum. This was easily accomplished, and an end-to-end anastomosis of the stomach and duodenum was made.

The patient's condition was good for three days, but she died rather suddenly late in the evening of the third day with a tremendously dilated stomach. A limited examination through the operative incision was made, but no additional abdominal pathology was found.

Gross Description of the Tumor.—The specimen, $10 \times 8 \times 5.5$ cm., consisted of 4 cm. of the pylorus of the stomach continuous with 6 cm. of the duodenum. It had been opened longitudinally, revealing a firm, nodular, pinkish-white mass $5.5 \times 5 \times 3.5$ cm. in area and 8 cm. in circumference. The mass was attached by a potential pedicle, 2 cm. in diameter, to the mucosal surface of the duodenum, encroaching upon the pyloric orifice. The base and the adjacent duodenal wall were not indurated. The serosal surface of the specimen opposite the base of the tumor presented a dimple-like depression 2 cm. long. The surface of the mass resembled that of the adjacent gastric and duodenal mucosa; it was pinkish-white, not ulcerated, granular, or friable. Lymph nodes were nowhere recognizable.

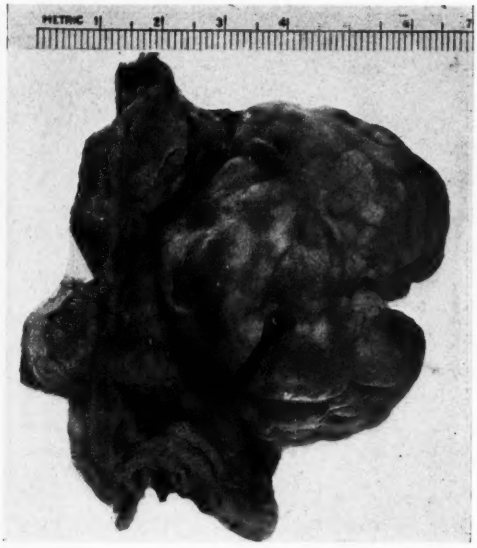

Fig. 5. Case 1. Photograph of the specimen removed at operation. The defect is due to the fact that an area was removed for histopathologic study.

Microscopic Description.—The mass was composed essentially of moderately anaplastic fusiform connective tissue cells. Some areas were predominately fibrillar, suggesting fibrosarcoma, while others were densely cellular with ovoid vesicular nuclei. A few mitotic figures were seen. The tumor, which was not encapsulated, manifested an invasive tendency. The pathological diagnosis was spindle-cell sarcoma.

Case 2. G. D., colored, male, aged 25, was admitted on March 19, 1931, immediately after vomiting a large quantity of blood. He complained of dizziness, generalized weakness, vomiting of blood, and a

Fig. 6-*A*. Case 2. The film made with the patient erect does not show the deformity of the prolapsing mucosa and polyp which is an important diagnostic finding. An ulcer crater on the lesser curvature is demonstrated.

Fig. 6-*B*. Case 2. A film made with the patient prone shows the wide pyloric defect due to hypertrophy of the gastric mucosa. The distal filling defect in the bulb is due to a prolapsed mucous polyp.

rash over the body. The onset of the present illness antedated admission by 14 months, beginning with occipital headaches in the afternoon and at night. Two months after the onset, the patient developed, in the left upper abdomen, discomfort and pain which radiated to the midline. The pain, which was continuous and paroxysmal at times, was not related to the taking of food. Five months later, the man developed over the entire body an itching rash which gradually increased in severity. The day before admission he vomited blood, and twice after admission he vomited as much as 500 c.c. of bloody fluid containing clots.

Physical Examination.—The patient was in serious shock, pulse 130, blood pressure 100/55, temperature 97 degrees. He was markedly anemic and weak and greatly emaciated. Desquamating papules were seen over the back and chest, but no abnormal rigidity or masses were noted.

Laboratory Examination.—Urine: very slight trace of albumin, occasional hyaline and granular cast, occasional erythrocyte, 4–6 leukocytes per high-powered field, numerous bacteria.

Blood: hemoglobin, 18 per cent; erythrocytes, 1,110,000; leukocytes, 13,500; polymorphonuclears, 79 per cent; lymphocytes,

19 per cent; myelocytes, 2 per cent; platelets, 380,000; initial hemolysis, 0.42; complete hemolysis, 0.28; measured cell, 7.76. Two days after admission the hemoglobin was 11 per cent and the erythrocyte count 890,000.

There were slight anisocytosis and marked polychromatophilia and oligochromemia. Several normoblasts, but no reticulocytes were seen. Calcium, 11.3; sugar, 140 mgm., non-protein nitrogen 37 mgm.; chlorides, 573 mgm; Wassermann, strongly positive.

Gastric analysis: free hydrochloric acid, 14; combined acidity, 14.

Stool: negative for ova and parasites, but strongly positive for blood; van den Bergh test, negative.

The patient's condition demanded emergency treatment on a presumptive diagnosis of bleeding peptic ulcer. Within 12 days he had improved sufficiently to permit of roentgen examination of the gastro-intestinal tract. Findings were a marked and constant deformity of the pylorus, with hyperperistalsis and hypermotility, and a spastic duodenal cap which filled with difficulty. The conclusion drawn was that the patient had either carcinoma or syphilis of the stomach.

The patient improved on specific treatment, transfusions, ulcer diet, and anemic therapy. The vomiting ceased and there was no further evidence of internal hemorrhage. He gained in weight and strength, gradually recovering from the severe anemia. Ten weeks after admission, his hemoglobin was 62 per cent, erythrocytes, 3,580,000, and he showed general clinical improvement.

Five weeks after admission (April 16), the roentgenologist reported the pyloric deformity still present and a small six-hour gastric residue, confirming the earlier conclusions. Approximately seven weeks after admission (April 29), the roentgenologist reported 50 per cent improvement and concluded that the patient had gastric syphilis.

The patient was dismissed May 28, 1931, apparently clinically well. He had gained 21 pounds in weight, his blood was normal, his Wassermann was negative, and his appetite and digestion were good. He was referred to the Dispensary for further observation and treatment. Subsequent improvement was recorded from the roentgenologic examination made in June, four months after the beginning of treatment.

On Nov. 5, 1931, there was a recurrence of the epigastric pain which was experienced within one or two hours after meals and was relieved by food. Several days later he had a severe attack of epigastric pain followed by the vomiting of approximately 500 c.c. of dark, bloody fluid. He immediately returned to the hospital.

The patient now looked well. His blood examination showed 95 per cent hemoglobin, 5,150,000 erythrocytes, and a negative Wassermann. The gastric analysis showed free hydrochloric acid, 13, combined acidity 14, and occult blood. The stools were positive for blood. There was moderate epigastric tenderness and axillary, cervical, and inguinal adenopathy.

He was referred to the X-ray Department on November 11 for further study. The report was made after a re-study of the films taken at the time of the patient's previous stay in the hospital and fluoroscopic examination as of the present.

Barium passed through the esophagus and into the stomach without delay. The stomach filled readily and was normal in size and position. It was slightly atonic, and peristalsis was very sluggish. The prepyloric region presented an unusual appearance. In the upright position it filled smoothly, with no defects. In the prone position, there were irregular filling defects which apparently were produced by objects within the lumen and not by induration of the stomach wall. At times the pylorus appeared serrated; again the defects were multiple and seemed to be surrounded by thin shells of barium

which extended through the pyloric canal into the duodenum. At other times the stomach contour was smooth to the pyloric ring, but in the antrum there was a single irregularly circular translucency which was outlined by a thin line of the opaque mixture. At such times the duodenal bulb was not visualized. There was a large ulcer crater on the lesser curvature, just proximal to the antrum. The duodenum was slightly dilated and never completely filled. Here, too, there were multiple central shadows of a translucent nature, varying in shape from oval to round, which at times were limited to the base of the bulb. These seemed to be a continuation of the gastric defects extending through a dilated pyloric canal. The filling defects were noted only in the prone position. At no time was there a disturbance of the contour of the duodenal cap.

Six-hour examination: There was a small gastric residue of from 10 to 15 per cent. The remainder of the meal showed approximately normal advancement and demonstrated no additional pathology.

Conclusion.—The findings were compatible with gastric syphilis with ulceration. There was also hypertrophied gastric mucosa and a pedunculated tumor of the stomach, which at times prolapsed through the pyloric canal into the duodenum. There had been no appreciable change since the first examination except that the ulcer crater was more penetrating.

Operation was performed on Nov. 18, 1931. The stomach was normal in size, and there were no adhesions. On the lesser curvature, about 2 in. from the pylorus, there could be felt an area of induration about the size of a half-dollar, extending to the posterior wall of the stomach. With the duodenum drawn up, a movable tumor could be felt just proximal to the pyloric ring, extending through the ring into the duodenum. The tumor could be seen through the wall of the duodenum, and could be pushed back into the stomach and back into the duodenum at will. We realized at once that we had to deal with a prolapsing tumor of the stomach.

The first three inches of the duodenum were easily mobilized after dividing the outer layer of the peritoneum. The distal half of the stomach and the first inch of the duodenum were removed in one piece, and the ends of the stomach and duodenum were united.

Pathologic Examination.—Study was made of a segment of the pyloric portion of the stomach 6 cm. long, 10 cm. in circumference at its upper extremity, and 3 cm. in diameter at its lower extremity. There were two ulcers, 3×3.5 cm. long, which extended to the distal plane of excision, but which were bordered proximally by hypertrophic mucosa which overhung smooth bases. The ulcers were irregular in shape, each 1.5 cm. in greatest width, and separated by a wedge-shaped, polypoid mass of hypertrophic mucosa, 5 cm. long and 2.5 cm. high, continuous as a polypoid mass 2.5 cm. in diameter, mucosal covered, occupying the orifice of the distal extremity. Attached lymph nodes were moderately enlarged.

Microscopic Description. — There was pronounced mononuclear cell infiltration, among which plasma cells were numerous, diffuse, and intense, about the ulcers, focal and bulky—chiefly perivascular—throughout other strata. An occasional gummatoid focus occurred, chiefly submucous in position. Endothelial hyperplasia and endarteritic intimal thickening was seen in the blood vessels. It is improbable that the reaction is non-specific. Polypoid masses have an organized hypertrophied mucosal structure, non-neoplastic.

Pathologic diagnosis was syphilis of the stomach with ulceration and polypoid hypertrophy of the mucosa.

Convalescence was normal, and the patient was out of bed on the eighth day. Roentgenologic examination, made three weeks following operation, showed the stom-

ach to be functioning satisfactorily with only a small six-hour gastric residue. The man has remained well up to the present time. A roentgenologic examination made in March, 1932, showed the stomach to be functioning very satisfactorily. There was no trace of gastric residue at six hours.

TUMORS OF THE DUODENUM AND BENIGN HYPERPLASIAS OF THE GASTRIC MUCOSA

The incidence of tumors of the duodenum and benign hyperplasias of the gastric mucosa prolapsing through the pyloric canal into the duodenum is increasing as we gain greater familiarity with the disease. Prolapsing hypertrophied gastric mucosa has been described recently by Pendergrass, and by Eliason, Pendergrass, and Wright.

A review of the accessible literature reveals 32 cases of benign tumors and four cases of sarcoma of the duodenum recorded. Up to 1921, of the 32 cases of benign tumor of the duodenum, 12 were discovered postmortem. During the past decade, 15 benign tumors and four cases of sarcoma of the duodenum have been verified by operation and histopathologic studies.

The youngest patient was 11 days old, the oldest 75 years. The greater percentage of cases has occurred above 35 years; the average age is 41.5 years. As far as can be determined from existing case records, the sex ratio is about equal. Approximately one-third of the tumors are adenomas, composed of Brunner's glands or mucous cells. Polypi, myomas, fibromyomas, fibro-adenomas, and papillomas occur with less frequency. Single case reports of hemangioma, cyst, lipoma, as well as mixed types of tumors, are recorded. The tumors vary in size from 0.5 to 10 cm. in diameter. One in every four is pedunculated. Hemorrhage and ulceration occur in 25 per cent of the cases, while an additional 25 per cent are associated with other pathology, such as gall-bladder disease, multiple diverticula, multiple polyposis, carcinoma, and, occasionally, intussusception. Ulceration with hemorrhage, intussusception, and carcinoma are the gravest dangers to life.

The chief symptoms are those referable to the upper gastro-intestinal tract, such as dyspepsia, indigestion, or other gastric complaints which are not characteristic. The symptoms of ulcer or carcinoma are often simulated, and roentgen examination is necessary to establish a diagnosis.

Sarcoma of the duodenum does not produce a characteristic clinical picture. Epigastric pain, associated with an enlarging abdominal mass, marked loss of weight, weakness and gastric hemorrhages are the usual complaints. Vomiting is profuse, is not related to meals, and does not always afford relief. Weeden states that the practically constant symptom of intestinal sarcoma is pain, usually colicky in nature. David emphasizes the diagnostic importance of the early onset of pain in the region of an enlarging palpable mass. A mass in the epigastrium, associated with colicky attacks of pain, hematemesis, loss of weight, cachexia—all progressive in severity—suggests malignancy, but the symptoms are not sufficiently characteristic to justify a dogmatic diagnosis of sarcoma. The clinical course resembles that of intestinal sarcoma in general.

HYPERTROPHIED GASTRIC MUCOSA PROLAPSING THROUGH THE PYLORIC CANAL INTO THE DUODENUM

Morphologic changes in the gastric mucosa productive of clinical symptoms have been investigated only in recent years. Roentgenology is contributing much information to the understanding of the pathologic condition as it exists in the living subject. Hypertrophy of the gastric mucosa has been described in this country by Eliason, Pendergrass, and Wright, who were the first to stress the clinical importance and de-

scribe the course, diagnosis, and treatment. Pendergrass has given an excellent description of the roentgenologic characteristics and has done much to promote interest in the subject. The series reported by these writers comprises three cases, two of hypertrophied gastric mucosa uncomplicated by the formation of a polyp, and one complicated by multiple polyps branching from the hypertrophied stalk of mucosa, prolapsing through the pyloric canal into the duodenum.

The symptoms resemble those of prolapsing tumors and tumors of the duodenum so closely that a clinical diagnosis without the roentgen examination is impossible to establish. The chief symptoms are those referable to digestion. They consist of epigastric discomfort, varying from mild to paroxysmal pain, the latter occurring when there is a ball-valve type of obstruction, weakness, loss of weight and appetite, constipation, gaseous distention, hematemesis, and melena. Epigastric tenderness will be observed frequently. Laboratory examination will show a low acidity, occult blood in the gastric contents and feces, and evidence of anemia in the majority of the cases.

Ulceration with hemorrhage may produce a severe secondary anemia simulating primary pernicious anemia. Eliason considers this of such importance that he recommends that no diagnosis of pernicious anemia be made before a roentgen examination of the gastro-intestinal tract is made. The high percentage of ulcers complicating tumors and hypertrophied gastric mucosa prolapsing into the duodenum has been attributed to the constant trauma to which they are subjected. This may also be an etiologic factor in the malignant degeneration which so frequently occurs. Eliason, Pendergrass, Wright, Miller, Finney, and others have emphasized the malignant tendency of these lesions.

The etiology has not been definitely established, but Eliason has advanced a reasonable premise which is supported by the cases recorded to date. He suggests the possibility of hypertrophied gastric mucosa as the forerunner of pedunculated prolapsing gastric growths. "A low-grade infection of the mucosa occurs as a result of chronic irritation (either physical, nutritional, functional, or bacterial) causing a local hypertrophy . . . once the hypertrophy is formed, it is increased mechanically by contractions of the stomach, peristaltic waves, and the pressure of the gastric contents as they are forced on the way to the pylorus. This results in their being 'pushed out,' or lengthened out, in the general direction of the pylorus. As the tissue continues to grow, it does so at the expense of the pedicle, which is stretched by the engulfing food being forced past and around it. Later when it is sufficiently long to do so, it is swept or carried into the pylorus by a peristaltic wave and produces the typical 'ball-valve syndrome' attacks of pain."

Pendergrass thinks that anything productive of chronic gastritis may give rise to the condition. He has observed the greatest incidence in those who are accustomed to overeating or who are chronic alcoholics. He also suggests that duodenal stasis, caused by congenital veils or the ligament of Trietz, may give rise to the condition. Syphilis has been named as an etiologic factor, but, in all the cases reviewed, the Wassermann was negative or the reaction not reported. The usual findings in the pathologic study of gastric syphilis have been atrophy of the mucosa, hypertrophy of the submucosa, and thickening of the muscularis. The present case confirms syphilis as an etiologic factor. The patient, who gave a definite history of syphilis, had other stigmas of the disease, including a strongly positive blood Wassermann, and improved generally on specific treatment. The specific infection was confirmed by histopathologic studies.

The present case, and two cases recorded by Pendergrass, lend support to the theory

of Eliason. In the present case, there was a hypertrophy of the gastric mucosa, part of which had become elongated into a stalk bearing a terminal wedge-shaped polypoid mass projecting through the pyloric canal into the duodenum. Windholz's pathologic description of chronic gastritis would tend to support the theory in the production of adenomas. In chronic gastritis, there is an excessive diffuse increase in the number of glands, as well as a change in the architecture of the mucosa. Microscopically, there is the impression of diffuse adenomas. There is a reduction of the interglandular tissue and a marked proliferative tendency of the newly formed glandular elements, which lead to the formation of circumscribed adenomas in some places. These may be surrounded by connective tissue which resembles a capsule. Hypertrophy is frequently found in the corpus and canalis and, occasionally, in the antrum.

The number of cases of hypertrophied gastric mucosa with polyp formation is too small to establish definitely Eliason's premise, but it has received reasonable support by the cases studied up to this time.

ROENTGEN DIAGNOSIS

All cases with vague gastro-intestinal symptoms, hematemesis, melena, and severe and unexplained anemia should have roentgen examination made of the gastro-intestinal tract. The conditions of tumor of the duodenum, prolapsing or primary, and benign gastric hyperplasia, prolapsing through the pyloric canal into the duodenum, should be specifically looked for. The roentgen characteristics have been fairly definitely established and the diagnosis is practically limited to roentgenologic studies. Excellent descriptions have been contributed, and those interested in the subject should consult the literature.

Tumors of the Duodenum.—The diagnosis, which is difficult, has been established in only four instances in the cases reviewed. The size of the tumor, the ease with which the defects can be overlooked during the fluoroscopic examination, and the multiplicity of confusing lesions involving the duodenum and the pre-pyloric area add materially to the difficulty.

The method of examination is not essentially different from that routinely employed. Emphasis is placed upon the examination in the horizontal positions, especially the right oblique prone, as the typical defects are not demonstrated when the patient is erect.

The stomach is free of filling defects in uncomplicated cases. If the duodenal growth is sufficiently large to encroach upon the lumen, there may be increased gastric peristalsis as is frequently observed in stenosis. In the presence of obstruction, with considerable dilatation and atonia, peristalsis may be subnormal or absent. Dilatation and atonia have been infrequently observed; a gastric residue is the exception.

The duodenal defect is characteristic. It is a central radiolucent filling defect with the periphery of the bulb shadowed as a shell of opaque mixture. It may be circular, vacuolar, or multilocular. There is no disturbance of the contour of the bulb, which may be dilated, but is usually normal in size. There is no six-hour residue in the larger percentage of cases. The defects are easily missed during the fluoroscopic examination, and numerous films of the finest detail possible should be made of the bulb, especially in those cases which are suspicious.

There is no type characteristic by which the nature of the growth can be determined. Waters suggests that a multilocular filling defect is in favor of a papilloma, while a vacuolar defect is indicative of an adenoma. A diagnosis of "tumor" is all that is essential for proper treatment, and any attempt to make a differential diagnosis between the different types of benign tumors and malig-

nant tumors causing central filling defects is subject to error.

The roentgen findings in the present case of sarcoma are essentially those attributed to benign tumors of the duodenum. There are, however, certain notable differences which must be attributed to "tumor" of the duodenum and which have not been previously observed. The stomach is markedly dilated and atonic, containing a considerable residue at six hours. The markedly dilated duodenal cap shows a central filling defect which is demonstrated in the upright position. In a case of papilloma prolapsing through the pyloric canal into the duodenum, Rigler demonstrated the defect in the upright position.

Prolapsing Gastric Tumors.—The primary duodenal tumor must be differentiated roentgenologically from pedunculated gastric growths prolapsing through the pyloric canal into the duodenum. The method of examination is the same.

The ultimate filling defect will be determined by the length of the pedicle, the size of the tumor, and upon the presence or absence of hypertrophied gastric mucosa prolapsing through the pyloric canal. In the uncomplicated cases, the duodenal defect will be the same as that produced by a duodenal growth. If the prolapsing tumor returns to the stomach and back into the duodenum with ease, the filling defect may be in the stomach at one examination and in the duodenum at another. There is usually no disturbance in gastric peristalsis unless there is obstruction, and there may be no prepyloric filling defect when the tumor has prolapsed. There is nearly always a six-hour residue, slight or considerable, depending upon the amount of pyloric obstruction. The presence or absence of a six-hour gastric residue has been of great importance in differentiating these two conditions. Golden states that a filling defect in the duodenal bulb, suggesting a non-malignant growth, when accompanied by a six-hour residue is in favor of a prolapsing tumor; when unaccompanied by a six-hour gastric residue, it is indicative of a duodenal tumor.

This finding has proven too valuable to be disregarded because of several exceptions. The ultimate value as a differential diagnostic finding will be determined by a larger series of case reports. It would seem that the presence, or absence, of a six-hour residue in cases of duodenal newgrowths will be determined by the amount of encroachment on the duodenal lumen. For that reason, it cannot be used as a differential point when the filling defect is large.

Prolapsing Hypertrophied Gastric Mucosa.—The roentgen appearance of hypertrophied gastric mucosa prolapsing through the pyloric canal into the duodenum is strikingly different from that of tumor. The extent of the gastric defect will be determined by the amount of membrane hypertrophied. If there is a large amount prolapsing, the prepyloric area will show a large filling defect with, or without, the presence of barium. The periphery may appear very irregular or serrated and may be mistaken for carcinoma. If the amount is insufficient to produce such a marked filling defect, one may see an appearance not unlike that produced by the spine pressing upon a barium-filled stomach. A smaller amount may cause only a thinning of the barium in the pyloric area compared with that in the remainder of the stomach. There is always a six-hour gastric residue, the amount being proportional to the degree of obstruction at the pylorus. At times a widened pyloric canal will be observed. This condition has been adequately described by Pendergrass.

As Pendergrass has shown, prolapsing hypertrophied gastric mucosa, complicated by a prolapsing polyp or newgrowth, will produce two filling defects, that in the bulb being due to the pedunculated tumor, that in the pylorus to the hypertrophied gastric mucosa (Fig. 6-*B*). There will be the additional findings described above. The ab-

sence of the filling defect in the upright position and the presence of the defects in the prone position are of extreme diagnostic importance.

The type of lesions described must be differentiated from the multiplicity of pyloric and duodenal deformities so frequently encountered in gastro-intestinal examinations. The confusion of the defects with those characteristic of ulcer, adhesions, extragastric masses, and carcinoma constitutes the most frequent error in diagnosis. The differential criteria must be considered briefly.

A diagnosis of the tumor as an ulcer of the duodenum is the most frequent error. Ulcer does not produce a central filling defect. The niche produces a constant disturbance in the contour of the bulb and may be associated with an incisura. The usual finding is a hyperperistalsis, with delay in motility. A large incisura may be confusing when, on complete filling, the peripheral borders may overlap, giving the impression of a central translucency. This can be distinguished under the fluoroscope. Adhesions usually produce an irregularity of the bulbar contour with fixation, gastric hyperperistalsis, and delayed motility. Tumors in the region of the pancreas, pressing on the barium-filled lumen, may produce a central translucency of intraluminal growths, but it would be exceptional to have the defect confined specifically to the cap and remain constant in all the horizontal positions.

The large filling defects produced by hypertrophied gastric mucosa may be confused with carcinoma of the stomach. In such a condition, the defect would be observed in the erect position; in addition, the usual signs of gastric carcinoma would be present. Cancer produces deep irregular filling defects in the gastric wall and peristalsis is absent from the area involved. The wall is resistant to palpation and the lumen is encroached upon. Contrasted with this type of stomach deformity is the rounded, central defect of benign growths, with undisturbed peristalsis and only rarely a palpable mass.

SUMMARY

A clinical diagnosis of tumor of the duodenum cannot be established without the aid of the roentgen examination. It is generally considered that a central filling defect in the duodenal cap, suggesting tumor, when accompanied by a six-hour gastric residue, indicates a prolapsing gastric tumor, while the absence of a six-hour gastric residue indicates a primary duodenal growth.

Hypertrophy of the gastric mucosa with polyp formation has been attributed to chronic gastritis. This premise has received reasonable support by observations of others and is also supported by the case of hypertrophied mucosa herein reported. The clinical and laboratory data would seem to confirm syphilis as the etiologic factor in the case reviewed here, although the literature does not reveal a counterpart to this type of syphilitic gastritis. Definite conclusions cannot be drawn from the single case. An extensive study of the gastro-intestinal tract in the early stages of syphilis may reveal this type of mucosal hypertrophy to be an early manifestation of organic gastric syphilis.

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Oxygen Lack Produces Condition like Insanity.—An emotional and mental condition resembling the effects of alcohol or temporary insanity results from a lack of oxygen such as that experienced by the aviator flying at high altitudes. Marked effects on the personality and mental processes of oxygen deprivation were brought out by experiments reported to the New York branch of the American Psychological Association by Dr. Ross A. McFarland, of Columbia University. The results of these experiments may lead to the development of new methods of studying the physiological and psychological causes of mental breakdown, Dr. McFarland believes.

Loss of memory results from the lack of oxygen at altitudes of 20,000 feet or more, and even below that height persons become unable after a period of an hour to keep their attention fixed or to perform tasks requiring judgment, patience, or persistence. These effects occur in an insidious manner. The subjects make mistakes but are not aware of them.

Emotional outbursts are characteristic, but individuals differ widely in their reactions, Dr. McFarland said. "Some reacted by marked irascibility of temper or by trying to break the apparatus to pieces, others by uncontrollable laughter, silliness, or flirting with the experimenter. There seemed to be some consistency in these reactions, suggesting that the basic and uninhibited temperament of the individual had been exposed. Lack of effort, indifference, and lack of ability to carry out tasks are very characteristic and quite as noticeable as the loss in accuracy."—*Science Service.*

WHY CONTINUE THE NITROCELLULOSE FILM?

A CHALLENGE TO HOSPITAL AUTHORITIES

By ROBERT S. MOULTON, Boston
Technical Secretary, National Fire Protection Association

ONE hundred and twenty-four persons died as a result of a fire on May 15, 1929, originating in nitrocellulose X-ray film stored in a Cleveland hospital building. The details of the fire, the fatalities due to carbon monoxide, nitrous fumes, and other fumes from the burning film are so well known that further description is unnecessary.

This fire, while the outstanding example that focused public attention on the hazard of nitrocellulose X-ray film, was by no means the first fatal example of danger from the film. As early as 1923 the National Fire Protection Association had noted the introduction of this hazard and, through its Committee on Hazardous Chemicals and Explosives, was preparing recommendations for the safe storage and handling of this inherently dangerous material. By 1925 these recommendations had developed into official National Fire Protection Association regulations which were also adopted by the National Board of Fire Underwriters.

It is interesting to note that the first nitrocellulose X-ray film fire recorded in the files of the National Fire Protection Association occurred in Boston on April 25, 1923. While at that time there was less general knowledge as to the proper methods of handling X-ray film, this particular storage was protected by automatic sprinklers which performed their designed function and extinguished the fire in its incipiency. Automatic sprinkler protection has been one of the essential features recommended for the protection of this hazard and it is significant that no film fire of any consequence has ever occurred where automatic sprinklers, vents, and the other recommended safeguards have been provided.

While it was a matter of common knowledge in the fire protection fraternity that nitrocellulose film constituted a severe hazard unless properly safeguarded, the information spread rather slowly in the medical field despite numerous papers on this subject and some local legislation. There were technical difficulties in the manufacture of the cellulose acetate ("safety") film when it was first introduced in 1924 which resulted in some dissatisfaction on the part of the roentgenologists. The manufacturing difficulties were gradually overcome, with a progressive increase in quality, until the safety film reached the point at which it gave the same results as the nitrate film. Owing to the higher manufacturing costs there still remained a slight price differential against the safety film and this presumably retarded its introduction in place of the nitrate film.

Following one of the earlier hospital fires in which lives were lost when fumes from burning nitrate film spread through a hospital building, suit was brought against the hospital for damages by a relative of one of the victims. The writer was called into court on this case recently for the purpose of showing that, prior to the date of the fire, the hazard of the nitrocellulose film had been known and that National Fire Protection Association regulations for its proper storage and use had been widely circulated. This evidence was rejected by the court partly on the ground that at the time of that fire the hazard of the material was not generally recognized by hospital authorities and their failure to comply with the published

recommendations of the National Fire Protection Association could not at that time be accepted as *prima facie* evidence of negligence. It seems likely, however, that if a similar fire were now to occur, the mere presence of nitrocellulose film without proper safeguards would be evidence of negligence, with probable legal liability for all the consequences of such a fire. Even if all humanitarian considerations be disregarded, it is difficult for the layman to see why hospital authorities should continue to take this chance. The use of safety X-ray film would not add ten cents to the cost of an X-ray examination for which the patient pays ten dollars or more. Why should the lives of patients and staff be jeopardized?

Following the Cleveland fire the National Fire Protection Association Committee on Hazardous Chemicals and Explosives made a complete review of its earlier regulations and issued a revised text based on the fire experience since the publication of the original edition in 1925. The fundamental principles of protection were not in any way changed, but a number of details were strengthened. The new regulations were drawn by the Committee on the assumption that the safety film would be rapidly introduced and would within a year or two completely supplant the nitrate film, old radiographs being kept in storage only for such period as it might be necessary to retain the medical histories of patients. The new regulations, while providing for appropriate safeguards for the handling of the material, exclude quantity storage from inside hospital buildings on the ground that it is unsafe in this occupancy to rely for the control of such a severe life hazard upon mechanical safeguards which might at any time be nullified by the failure of the human element. Under the regulations, hospitals have the option of placing quantity storage of nitrocellulose X-ray film outside of the building, or of storing it in a roof structure or in a detached building, or the use of cellulose acetate ("safety") film. Small quantities of nitrate film in current use may be kept in properly constructed vented storage cabinets inside the building.

The great majority of hospital authorities, once the hazard of the nitrocellulose film was forcefully brought to their attention, took prompt steps to safeguard their old radiographs and confined their future purchases to the safety film. There still remain, however, perhaps a quarter of the entire number of hospitals in the United States that continue to use the nitrocellulose film. It is difficult to understand this. The safety film is, to be sure, slightly more expensive, though recent price reductions have made the price differential between the two types of film small. The safety film is now offered by all the film manufacturers and gives photographic results identical with the nitrocellulose type.

While, as indicated, the use of nitrate X-ray film can be rendered relatively safe by the careful and constant observance of all the National Fire Protection Association regulations, it would seem the part of mere common sense, on account of the constant expense of providing and maintaining the necessary safety factors and the ever-present danger of the failure of the human element, for all hospitals to use exclusively the safety film.

Will it be necessary to have another film fire disaster before the remaining hospital authorities that still use the nitrate film recognize their responsibility in safeguarding the lives of patients against this hazard?

THE PROBLEM OF ETHICAL EDUCATIONAL PUBLICITY IN RADIOLOGY[1]

By B. C. CUSHWAY, M.D., CHICAGO, ILLINOIS

MUCH serious consideration is being given at this time by the various medical organizations to the problem of publicity and public education. There is a definite change in the attitude of the medical profession and the press toward the problem, evidenced by the appointment of special committees and health bureaus. The personnel of these bureaus and committees devote part, or full, time to the problem of educational publicity.

For example, there is *Hygeia,* a publication of the American Medical Association. This magazine reaches the public, as well as the general profession, directly. In addition to other educational activities, the American Medical Association delivers a regular program over the radio. The Association also approves the use of the lay press as a method of educating the public. The Illinois State Medical Society has a committee which works in co-operation with, and supervises the effort of, several lay workers who are engaged in educational and publicity work through all available channels. The New York Academy of Medicine and the Medical Society of the County of New York work through a medical bureau, one function of which is to provide contact and co-operation with the lay press. At a recent clinical congress of the American College of Surgeons, the incoming president stated that not only was it necessary to adopt a change in attitude in medical policy, but it was also necessary to improve the contact between the medical profession and the public.

When a medical organization is arranging for a local congress or convention, it is accepted practice for the local committee of arrangements to appoint an educational and publicity committee, the duties of which are to provide contact with the lay press and to assist in disseminating educational material.

It would seem that, during the last few years, there has been a constantly increasing tendency to promote educational publicity. I quote from an editorial appearing in the New York *World Telegram,* Oct. 27, 1931, commenting on the press releases during the clinical congress of the American College of Surgeons, at New York City.

" 'One of the outstanding features of the recent Clinical Congress of the American College of Surgeons,' according to an editorial in the official organ of the New York County Medical Society, 'was the dignity and discrimination with which the lay press covered the meeting.' . . . In the many columns which appeared in all the newspapers, there was not an exceptionable statement or an item to which the most captious critic could object. A medical meeting of any magnitude is easily exploitable by seekers after sensationalism or purveyors to it. The newspapers must have had many opportunities to turn the Clinical Congress into a carnival of overstated claims and overdrawn personalities. It would be hard to find a better example of enlightened reporting in the medical field than the publicity given to the College of Surgeons' meeting.

"This editorial attests to a remarkable change in the attitude of the press and the medical profession toward one another in New York City. It especially shows the change in the attitude of the medical profession toward the publication of medical news. This change began about four years ago, when the Academy of Medicine and the New York County Medical Society estab-

[1]Read before the Radiological Society of North America at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

lished an Information Bureau for co-operation with the press and inaugurated yearly get-together dinners.

"The doctors began gradually to yield to the requirements of newspapers regarding medical events and developments. The newspapers, no longer required to get such news in the best way they could, often from the press-agent type of doctor, began to avail themselves of the new facilities. The results have been good on both sides.

"The results will continue to be better as the medical profession more and more shakes off its traditional secrecy, which the public, through independent means of enlightenment, has long been in process of penetrating."

Possibly results such as this may be looked upon as indicative of progress in the contacts between the physician and the public. They may also indicate that organized effort, through a special agency, will produce better results than unsupervised, sporadic, individual effort.

The release by individuals of educational and publicity material through the lay press has frequently resulted in distortion of fact and in sensationalism. It has had the effect of carrying the stigma of personal advertising. In the writer's opinion, this has been largely due to lack of understanding between the physician and the press. The press was compelled, in most instances, to pick up crumbs of information from any source other than a reliable one. It was immediately suspicious of any individual who offered copy. There was a lack of desire to publish such material because of the danger of advancing some scheme which might be improper, and because of the criticism of personal advertising and promotion by an individual.

That the situation is, and will continue to be, improved by systematized effort through a committee, or bureau, is self-evident. The lay press to-day is undoubtedly the most powerful channel available for the dissemination of educational material. Is there any reason why medical units should not take advantage of the service of the press, particularly if they are assured that their problems will be handled fairly? With a properly organized agency serving as the mouthpiece of the groups, the best type of educational effort could be secured. This committee, or bureau, should direct and supervise the type of material released for publication. In this way a controlled and directed informative effort could be made.

In the three-year period of endeavor of the Publicity and Educational Committee of the Radiological Society of North America, a great change has taken place in the attitude of the press toward our efforts. Editors and managers apparently realize the advantages of securing material from a central committee or bureau. They are also evidencing appreciation of the objects of our program and are able to handle our material more intelligently. We are offered better service each year in the assignment of a superior type of writers of press articles and in being allowed more space. There is less tendency to make changes in the leads of press releases given for publication. In brief, there is an inclination to appreciate our effort, witnessed by the absence of distortion of material and sensational headlines.

The writer feels that some organization must be a pioneer in this effort in order to promote a better understanding between the press and the physician. The Radiological Society is an organization of physicians. That the members are engaged in the practice of radiology should not detract from the fact that they are qualified graduate physicians, having special experience in radiologic work. The radiologist has the same general aims and policies as have other members of the medical profession in their contact with the public. Our aim, just as that of the general profession, is to place at the disposal of the public advanced ideas concerning the scientific effort of radiology to benefit human-

ity. In order that the people should benefit from radiologic practice, it is necessary that the public should know what the science of radiology is. In addition to knowing something of what a radiologist can do to benefit it, the public should know that the radiologist is a qualified physician who has had special training and experience in the practice of radiology.

With a proper understanding between the lay press and the radiologist, the public should receive an intelligent idea of the advantages which radiology brings. This can be done without distortion of fact, sensationalism, or personal advertising. One of the objectionable features of the relationship between the physician and the lay press is the stigma of personal advertising. While this could be eliminated by having the press releases published in the name of a committee, or bureau, at present, because of the general insistence by the press that all releases must be statements by an individual, it cannot be done. Such was found to be the case just recently during the congress of the College of Surgeons, in New York City. There are indications that, by slow, steady, organized effort on the part of the medical societies, the attitude of the press may be changed. If this change can be wrought, most of the objectionable features of medical educational work through the lay press will be eliminated.

Should a medical unit decide to engage in educational and publicity effort, what change in policy would be involved and what avenues for dissemination of material are there? The following, described as the "yardstick of ethics," is quoted very largely from the Bureau of the New York Academy of Medicine and the New York County Medical Society.

"The present tendencies in social and economic life have made it desirable that the medical profession, both as an aggregate body and through its individual members, should become more articulate in its relation to the public.

"However, this being something of a departure, it is necessary that a working set of principles be formulated to guide physicians in their public contact with the community, to the end that the best interests of the community be served and that ethics be not violated.

"In considering the common avenues through which the profession and individual physicians may address the public, namely, the press, the radio, the public platform, and popular publications, we find three possible types of approach. These are publicity, propaganda, and public health education.

"*Publicity.*—Publicity we witness in the medical world under two aspects. In one, it gives due public notice of events which constitute legitimate news, such, for example, as the election of new officers in a medical organization; the opening of a new hospital; the award of a prize for distinction in medicine, and the like. Such publicity is legitimate and desirable, and the use of a physician's name in this connection is not reprehensible.

"There is, however, another form of publicity, unfortunately employed by a small section of the medical world, which has for its aim the exploitation or advertisement of an individual through mention of his name in the public press.

"In such publicity, the comings and goings of the individual are features, his connections, achievements, and honors are mentioned, and he is thereby deliberately, and often without any warrant, given undue prominence in the public eye above the merits of his professional equals. This form of publicity is objectionable, because its aim is reprehensible and the effect upon the public and upon the profession will be deleterious. This type of publicity among physicians cannot be countenanced and those guilty of it are liable to discipline.

"*Propaganda.*—Propaganda has for its main objective the arousing of public interest in supporting and acting on health matters.

"In propaganda, emphasis is placed on some matter of public health interest and only incidentally upon the physicians connected with it. Such subjects as tuberculosis prevention, cancer control, diphtheria prevention, are legitimate public health items for propaganda. The appearance of physicians' names in connection with such agitations is, by the exigencies of the press practices, necessary and allowable.

"*Public Health Education.*—Public health education differs from publicity and propaganda by the nature of its content. A statement, for example, that measles is a much neglected and dangerous disease made by Dr. Jones may serve as a typical example of a public health education message. Such a statement should not give special prominence to its maker. On the other hand, the statement is given impressiveness and authoritativeness when it emanates from a representative physician or from an official medical body. Such a physician speaks, not for himself, but for the profession. He serves merely as the mouthpiece through which is expressed a fact universally agreed upon by physicians.

"*Radio Broadcasting.*—The radio presents a number of singular problems which need individual consideration. It is highly desirable that the medical profession should take advantage of the opportunities for constructive propaganda and for health education presented by the radio. And yet the radio is a medium in which the personality of the speaker, understood in its widest implications, counts for much. Anonymity on the radio is, therefore, incongruous. A physician making an address on the radio must, of necessity, be introduced by name. More than that, to establish his right to speak, his standing or connections, educational or associational, must be given.

"All of these requirements can be fulfilled without violence to good taste or ethical procedure. The speaker's name may be given by the announcer without superlative references to his abilities or achievements. 'Dr. John Jones, Clinical Professor of Medicine at the X. Y. Z. University,' will suffice as an introduction. Dr. John Jones, who is a practising physician, should not be introduced as an internationally famous authority, etc.

"In the body of the radio paper, references to the person of the speaker, his singular achievements, unique and outstanding practices, should be kept down to an absolute minimum. In theory, the physician speaking on the radio is the vocal representative of the medical profession addressing the public. He brings to the public the fruits of many men's labors. In this, he is the custodian and administrator of the wealth accumulated by the scientific endeavors of the profession. His personal interests and individual convictions must be placed secondary to the interests and dominant convictions of the profession. There are proper channels provided for the advancement of a physician's medical ideas.

"It is desirable that talks over the radio by physicians should be given under the auspices of the designated committees of the medical organization concerned.

"Commercial organizations may purchase time on the air with increasing frequency in order to procure good-will, and use it for broadcasting public health information. Frequently, physicians are employed to compose and deliver such broadcasts.

"Provided that the commercial organization is of reputable standing, there is no objection to physicians accepting such employment. A physician must not, however, make his address an endorsement or testimonial for the product, or products, of the organization on whose time the broadcast is given.

"In order to safeguard himself and the profession, when such employment is of-

fered him, a physician should confer with the Medical Information Bureau, both as to the standing of the commercial organization with which he is to make a connection and the contents of the paper, or papers, he proposes to broadcast.

"It is also important that the announcer's continuity should be acceptable. No exaggerated or unwarranted claims should be allowed, nor should the announcer be permitted to imply that the speaker endorses the commercial organization or its products.

"*Magazines and Periodicals.*—Articles written by physicians for magazines on medical topics affecting the profession should be subject to pre-publication review by the local medical organizations.

"*Summary.*—The full intent of these considerations is to facilitate, and in no way to hamper, educational contact of the profession with the public. They are designed to encourage the articulateness of the profession. They provide against objectionable publicity by self-seeking individuals whose only design is to aggrandize their person beyond all merit."

In conclusion, the writer desires to call attention to the need of legislation for the protection of the radiologist and also the public. This is shown by the report of Dr. Leon J. Menville, Editor of RADIOLOGY, read at the Los Angeles meeting. Dr. Menville sent out questionnaires to the various state boards of medical examiners with the idea of ascertaining the status of radiology. Quoting from his report on the result of this survey:

"The replies received indicated that, while radiology was considered useful in its application to medicine, it was not of the same importance as the other specialties of medicine. Many States did not consider that it was necessary for the radiologist to be a physician and for this reason he could not expect to receive any consideration at the hands of organized medicine."

It was shown that 25 per cent of the medical practice acts throughout the country did not give the same protection to radiology as to the other specialties. In 36 per cent of the replies, the practice of radiology was not considered the practice of medicine. In 25 per cent, it was thought unnecessary for the radiologist to be a licensed physician in order to practise.

Quoting further from Dr. Menville's report:

"One of our very important functions is to acquaint the medical profession through organized medicine with the indications for, and limitations of, radiology. We have been derelict in not educating the public to the usefulness of our specialty and of the dangers and hazards encountered with this agency in the hands of the incompetent, and that even disastrous results often follow erroneous diagnosis or treatment by the inexperienced, either of the laity or of the medical profession. Such an education should reach members of local and state governments, and would prove of incalculable value helping to amend the medical laws so as to protect the people at large and to give proper recognition to radiologists in those States in which cults and 'isms' are permitted to practise radiology. The need for such education is best demonstrated in an advertisement which appeared in one of the important newspapers in a large American city. The heading was, 'Free X-ray regardless of age, sex, or condition. If you are not in good health, we will give you a standard size X-ray photograph of your spine.'

"It is a duty imposed upon us in conscience to help protect the unsuspecting public against such conditions."

Is it not a fact that our legislators and legislative bodies are a part of the lay public? How can we expect favorable legislation when the legislators know little of the scope or the benefits of radiology? How can we expect favorable public opinion if the

public is uneducated in the benefits of radiology? It would seem desirable to carry out a definite educational campaign if we wish to secure favorable public opinion and legislative action for the protection of the public and the radiologist. This campaign should be carried on through the lay press, the public platform, the radio, popular magazines, and all other channels. The principles of practice in the conduct of such a campaign by a committee, or bureau, should be developed as an aid to the membership in showing the course to be followed in any given case. While certain principles should be followed in educational work, strict adherence to fixed rules should not be demanded. The policy should be to secure co-operative effort between the committee and the membership. It is the writer's opinion that educational publicity should be carried out as an organized effort through a committee or bureau, and we should make use of all available channels as previously described. As a result of this educational effort, radiology will become of greater benefit to humanity.

Ultra-violet Light Breaks Comet in Half.—A theory has been presented before the American Geophysical Union by Dr. H. B. Maris, of the U. S. Naval Research Laboratory, that, during periods when many sunspots are visible, the ultra-violet light streaming out from the sun may increase as much as a thousandfold.

The atmosphere of a comet is transparent to visible light but strongly absorbs ultra-violet light, which, because of this absorption, exerts a pressure on it. The effect on the comet is to create a strong wind in its atmosphere, moving away from the sun. Thus that part of a comet that feels the pressure most may get a violent jolt when a new whirlpool appears in the sun.

Magnetic storms, those great fluctuations of the earth's magnetic forces, often accompany or anticipate the unusual changes in comet activity. Since the magnetic effects are known to be due to the ultra-violet surges associated with bright spots on the sun, this forms additional support for the new theory of comet behavior.

Comet activity shows itself by changes in the brightness of the atmosphere of the comet, similar to those observed on the earth during a display of the aurora or northern lights. The aurora is caused by increased ultra-violet light from the sun, said Dr. Maris. It occurs at the same times as the magnetic storms.—*Science Service.*

RADIOGRAPHIC DIAGNOSIS OF EARLY PREGNANCY[1]

By A. JEROME THOMAS, M.D., SHREVEPORT, LOUISIANA

THE normal uterus is radiolucent, the ovum, embryo, and fetus being more or less radiopaque. The amniotic fluid has a calcium content.

Before the twelfth week, sufficient of the skeleton is developed to register positive markings on the film. At the 5–6 week period, the following should be present:

Nuclei of ossification centers of the shaft of the clavicle
Mandible
Shafts of the ribs
Laminæ of the vertebræ.

At the 7–9 week period, there should be present:

Shafts of the femurs and tibiæ
Cranial bones and orbital arches
Bodies of vertebræ and scapulæ
Shafts of ulnæ and radii
Shafts of metacarpals and metatarsals.

Radiographic research was made, using non-pregnant women and post-operative specimens. The films gave positive results and the markings visualized were used as known positive markings of each period of gestation. In all experiments, a constant finding was that the closer the specimen was placed to the cassette, the greater the detail, definition, and visualization.

First Period (6–7 Weeks).—The ovum in the lateral position registers as a semi-crescentic area of increased density. In the anteroposterior position, its shape is circular or oval.

Second Period (8–12 Weeks).—The embryo is in the lateral position, its immature skull resembling a broken ring with a very thin edge. Later the ring shadow shows without any broken areas, the edges are thicker, the skull enlarges rapidly, and the circular shadow increases its size. In the anteroposterior and postero-anterior positions, the skull shows only small, thin, linear markings, which become thicker as gestation advances. The vertebral column shows positive diagnostic markings simulating a chain of small discrete dots distributed almost horizontally or slightly curved, arranged as a short string of small beads. These enlarge and thicken, then small lines, distributed at right-angles to the dots, are visualized. A later check-up shows these markings to be the ribs. Subsequently, the extremities may show as very small, thin, linear, longitudinal markings.

Third Period (15-17 Weeks).—The fetus is sufficiently developed and almost the entire skeleton is visualized. Among pathologic factors that are radiopaque are: calcified fibroids of the uterus, lithopedion, calcified lymphatic glands, calcified ovary, calcification of the iliac or other arteries, stone in bladder, intrapelvic cysts, and hemorrhagic infiltration of a broad ligament that has undergone calcareous degeneration. The differential diagnosis can be made and the above lesions eliminated by means of the size, shape, and distribution of the opaque markings. If necessary these may be correlated with the case history and the clinical features. In doubtful cases, another examination may be made in two weeks, or one week, if the case is urgent. In these cases, if the markings are caused by any of the above lesions, the radiopaque markings will all show similar size, shape, and distribution. If they are due to pregnancy, the markings will be increased.

Many factors are capable of causing non-visualization of the diagnostic markings of pregnancy, such as extreme power line fluctuations, inefficiently functioning X-ray equipment, use of an X-ray tube with a large sized focal spot, and use of the wrong

[1]Read before the Radiological Society of North America, at the Seventeenth Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

radiographic technic. An excess voltage will burn up or obliterate the fine detail, and insufficient voltage will fail to produce visualization. Malalignment of the ovum, embryo, or fetus to the tube target is very frequently the cause of failure to visualize early markings. This is hard to eliminate, as the position of the fetus can not be predetermined in the early period. In anterior displacements of the uterus, the fetus is further away from the cassette, producing an exaggeration of the fine detail, so that, at times, its identity is lost. Motion of the uterus, or contents, from failure to suspend respiration, or movements of the fetus or involuntary muscle tissue during radiographic exposure, gas pockets or feces in the pelvic colon, bladder full of urine, overlapping of shadows of the fetus and the maternal pelvic bones (to mention some factors) may obliterate the diagnostic detail of early pregnancy.

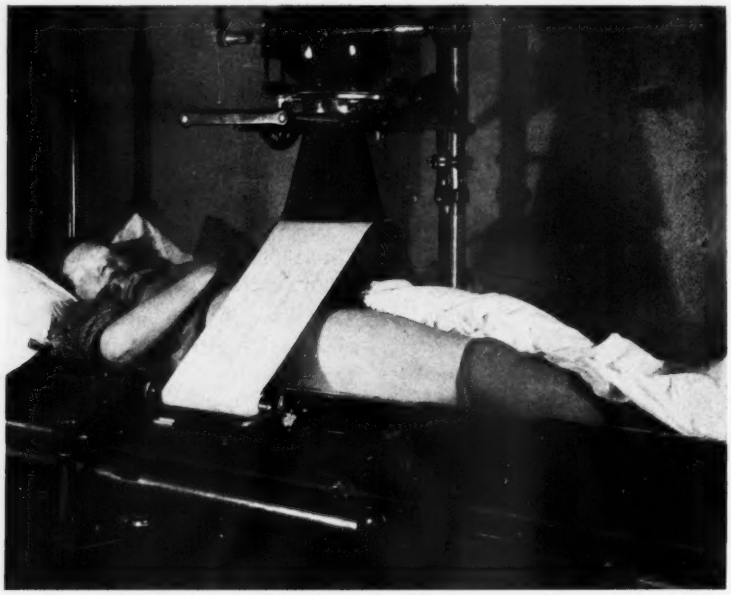

Fig. 1. The radiographic equipment, the relative positions of patient and the X-ray tube, as used in the Thomas displacement technic for diagnosis of early pregnancy. The air-inflated rubber bag is placed in a lateral position over the left iliac region and with proper compression will displace the uterus to the right of the median line, away from the maternal sacrum and pelvic colon and much closer to the pelvic floor and cassette, minimizing distortion and facilitating the visualization of the finer diagnostic detail of early pregnancy.

CORRECTIVE MEASURES FOR ADVERSE FACTORS

A useful adjunct is a rubber bag inflated with air, placed over the lower abdomen and under the compression band of the Potter-Bucky diaphragm. This is positioned obliquely to the left of the median abdominal line. The canvas band is tightened until firm, uniform pressure is obtained and maintained so that the uterus is displaced toward the right iliac fossa, away from the sacrum and coccyx, and downward toward the pelvic floor, much closer to the cassette. Any gas pockets are eliminated, as the uniform equal pressure usually produces an equal distribution of the gas away from the

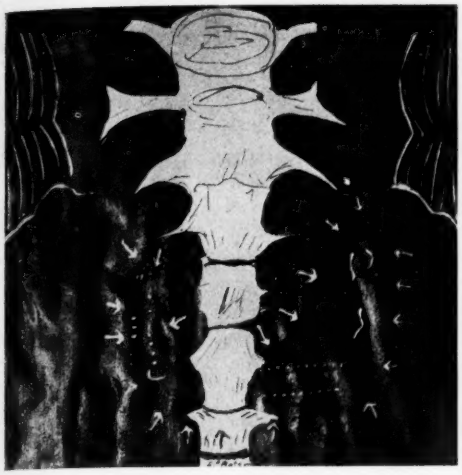

Fig. 2. Diagnostic markings of pregnancy from the tenth to eleventh week are those of the immature vertebral column, which is visualized as a single or double row of discrete dots arranged like a string of very small beads. This illustration is a drawing from the X-ray negative of a twin pregnancy of ten weeks and five days' duration.

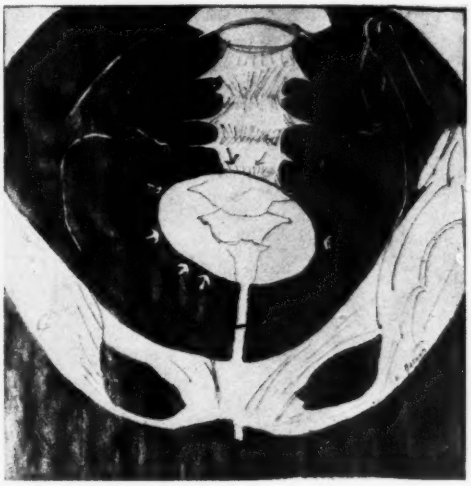

Fig. 3. Diagnostic markings of pregnancy from the sixth to the seventh week. The ovum is visualized during this period as a semi-crescentic area of opacity or as an egg-shaped opacity, the differences in the shape being due to the position of the ovum and its relation to the cassette, such as the lateral, anteroposterior, or oblique. The opacity is due to the calcium content of the bag of waters and with normal blood and tissue chemistry may be visualized as early as the fifth week.

radiographic field. The uterus is also immobilized and is placed in the best position possible to show any radiopaque markings without overlapping of shadows from the maternal pelvic bones. The angle of projection of the central ray is slightly oblique, causing a slight enlargement, sufficient to make the markings more legible.

RADIOGRAPHIC EQUIPMENT

The X-ray machine should have ample capacity for rapid radiography and accurate controls. The X-ray tube should have a fine focal spot with a maximum load capacity, much greater than the tubes that are commonly used. An accurate motor-driven timer is necessary to duplicate exposures. A Potter-Bucky diaphragm, radiographic cones, and a rubber bag such as used for kidney compression are also used. Cassettes should be mounted with double, super-speed screens; super-speed films should be used. Not only will these cut down the K.V.P. and exposure time, but they will improve the quality of the roentgenograph.

RADIOGRAPHIC TECHNIC

The bowels and bladder must be empty; if the bladder contains much urine, it will cause a confusing shadow. The patient is placed horizontally on the Potter-Bucky diaphragm, her pelvis centered to the center of the diaphragm, in the anteroposterior position. The uterus is located and displaced to the right of the median line; the inflated rubber bag is placed obliquely to the left of the median line and under the compression band of the diaphragm. This band is gradualllly tightened while the position of the rubber bag is maintained manually. The tube target should be vertical; in this position any radiopaque markings will show to advantage. For 10×12 films, use an 8-inch cone; for 8×10 films, use a 5-inch cone.

CONSTANT FACTORS

Distance, 25 in., ma., 40; exposure time, 2.5 seconds. The voltage is the variable fac-

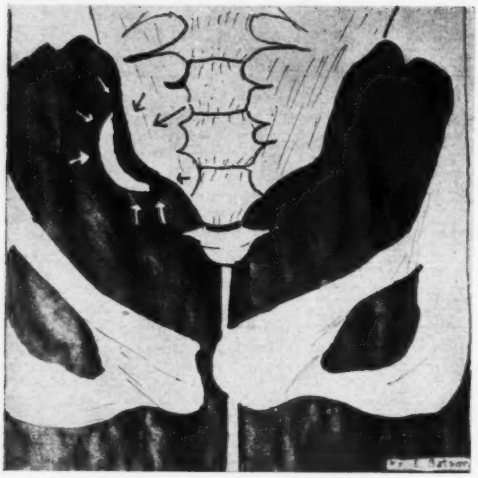

Fig. 4. See caption under Figure 3.

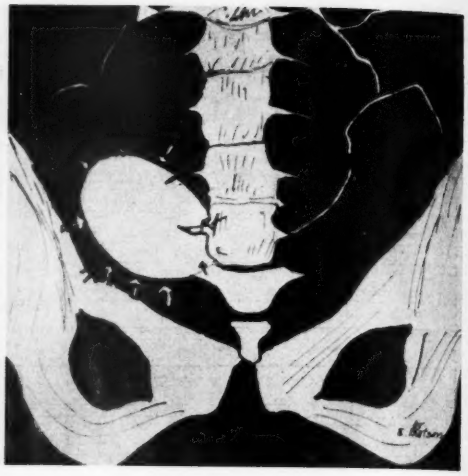

Fig. 5. See caption under Figure 3.

tor. The precise voltage is seldom predetermined, as the subcutaneous tissues may contain an excess of fat or fluids, or the lower abdomen may have an extreme depth. The voltage should be varied until the correct penetration and radiographic density are secured—it will be somewhere between 60 and 90 kilovolts peak. It is essential that the dark room technic be precise and standard in all stages of the processing of the films.

The films must show the maximum detail, sharpest definition, contrast, and radiographic density with the minimum distortion, otherwise pregnancy at the twentieth week will not be visualized.

CONCLUSIONS

This is not a final report. More experience, with ample clinical material, is necessary before the various phases are standardized; however, sufficient positive results have been obtained to justify the belief that pregnancy can be radiologically diagnosed as early as the sixth week. Experimental research, using non-pregnant women with post-operative specimens of pregnancy, has always shown positive markings at this period of gestation. Therefore, the visualization of these known positive markings in a suspected case of pregnancy should have considerable diagnostic value and should be regarded as the first sure sign of pregnancy, long in advance of the definite clinical signs.

DISCUSSION

DR. LEROY SANTE (St. Louis, MO.): I reviewed Dr. Thomas's films in the scientific exhibit and I must congratulate him on his painstaking work. I feel, however, that, as a radiologist, I would hesitate to make an absolute diagnosis unless I could actually see some of the bony structure of the fetus—that is an essential in the diagnosis.

The earliest embryo I can recall having seen was ten and a half weeks old. It could be seen and the bony structure was very finely outlined, but infinite pains were required to secure this result. We have the absolute confirmation, however. The patient asked for examination to determine if she was pregnant. On being informed by her family physician that she was, she straightway went to the drug store, obtained the necessary implements, and performed an abortion upon herself. Within 48 hours she was admitted to a hospital and delivery occurred. I secured the fetus. I have her history from the day of last menstruation to the actual date of the delivery of the fetus,

which was within exactly ten and a half weeks. Measurement of the fetus corresponds exactly. That is the earliest pregnancy in which I have had absolute proof of the age of the fetus—the earliest one we have been able to show with any degree of satisfaction.

DR. M. J. HUBENY (Chicago, Ill.): With Dr. Sante, I believe that we should be a little cautious. Dr. Thomas attempts to establish two points which it is very necessary to consider: first, the medical diagnosis, and, second, the possibility of a legal complication. Assuming that one confuses a fibroid with a possible pregnancy, the legal results might not be so very pleasant. Because of these possibilities, we might err on the side of commission rather than omission.

Dr. Thomas presumably makes his diagnosis from two different angles: a density, probably elliptic, without signs of ossification, and then, later, the more customary method of recognizing the centers of ossification.

He also has advised repeated examination. If the physician is in doubt, following an interval of two or three weeks, the suspicious area might again be examined to see if any progress is to be noted that might verify the diagnosis. That is a correct and cautious procedure for it is sometimes difficult to make a diagnosis of pregnancy, particularly in a multipara. In the primipara, it is not always so hard, but certainly, in a multipara, we find difficulties.

The essayist has covered the technical aspects of the work very well; these constitute a problem that we always have to take into consideration. However, the greatest obstacle we meet is the fetus itself. The fetus must have certain definite factors before we can recognize it. Therefore, we are dependent not so much on the technic as we are upon the visibility of the part, namely, the fetus.

It is peculiar that, in normal gestation, we have a variation all the way from eight months, about 240 days, to eleven months, about 330 days—there is considerable latitude, even in normal pregnancy. Therefore, we are going to have considerable latitude in the growth of the embryo and also in its ossification.

No doubt, in occasional instances, we will be able to favor ourselves by depending upon the history of the cessation of menstruation, which is rather inaccurate, but it is the only factor that we have.

Then there is the other angle, that we base the size of the fetus and the radiographic centers of ossification upon abnormal pregnancies. We are not truly dealing with a normal condition. Many of these embryos have been made possible for handling by abortion or by accident, such as a tubal pregnancy or a fibroid uterus that contained a pregnancy. So the question arises, How justified are we in calculating the age of the fetus? That is one of our great problems—to know really how old the fetus is, because our calculation starts from a very vague point.

The obstetricians calculate that, up to the age of five months, the square of the month gives the approximate length of the fetus. Assuming that the fetus is five months old, the length would be 25 centimeters. If it is six months, add five, making it 30.

Another angle to consider is the weight, or volume, of the fetus. After the fifth week, up to the time of delivery, the fetus is about 800 times heavier than it was at about the fifth week. This indicates that the human being grows fastest in the uterus, and that the greatest rate of growth is during the later days of intra-uterine life.

I had the privilege of examining quite a number of embryos, varying in age periods from seven weeks to maturity, at the University of Chicago. I placed some of these directly on the film, naturally the most favorable method of examination, because there are no intervening maternal parts and, consequently, the radiographic evidence is better. I found that there is a good deal of variation in the centers of ossification. Normally, the clavicle and the inferior maxilla ossify at about the seventh week, the superior maxilla at about the seventh or eighth week, and the occiput at about the eighth week. But in some of the embryos, the ages of which I had approximately calculated to be those mentioned,

I was not able to demonstrate those centers. So, if we were going to depend upon our diagnostic effort *in uteri*, I am afraid the odds would be very much against us.

There is also quite a difference in the degree of ossification, as the following figures will show.

Age, seven weeks; tubal pregnancy; length of fetus, 2.23 centimeters.

Age, 66 days; fetus contained in a fibroid uterus; length, 3.5 centimeters.

In neither one were there any evidences of centers of ossification.

Age, 12 weeks; female, an aborted fetus; length, 7 centimeters. The superior maxilla was the only bone I could demonstrate radiographically.

Age, 11 weeks; tubal pregnancy; length, 4.8 centimeters. Centers of ossification were seen in the head, vertebræ, and ribs.

To discharge our obligations we want to be certain; in other words, there is such a thing as making a conjectural diagnosis, but there is also a definite one.

Dr. Thomas (closing): To visualize early pregnancy requires a refined technic as well as special equipment. There is no secret to my technic, which I call soft tissue—the formula is plain. I think that I may have simply improved upon the technic of others.

Visualization in suspected tubal pregnancy has been made possible by the injection method. Dr. Heuser's markings and my markings checked identically, but his method requires considerable instrumentation and much exposure. My method gives similar visualization, but without discomfort from personal exposure and instrumentation, to say nothing of pain from the distention of the fallopian tube.

All of my cases were checked from the menstrual data, radiographic exposure, and date of delivery. As the period of gestation, 280 days were allowed. With this as a working rule, I determined the age period of my cases.

As concerns ossification that can be visualized on a film during early pregnancy, we should not follow any fixed rules, as there are many exceptions. In fact, the text-books on the osteology of the embryo will have to be revised for I am sure that many errors are apparent to those who have investigated sufficiently. The age should not be determined by the size and weight—these vary too much. Some time between the ninth and twelfth weeks, the chain of discrete dots which represent the nuclei of the ossification centers of the lamina of the vertebral column, can be visualized. It is also possible for the woman to be pregnant and the markings not be visualized. This can be due to factors over which the radiologist has no control, such as hypocalcemia, in which the marked deficiency of the calcium content is such as to make the skeleton almost radiolucent. If the ossification centers are demonstrated on the film, I would be willing to go to court any day—and I think that anyone else could—and swear that the woman was pregnant for the reason that there is nothing within the female pelvis that will give such markings except pregnancy.

The size and weight of all specimens will vary during the prenatal period just as much as they do at, and after, birth. Some babies have weighed two pounds or less, others go over 12 pounds, and a case is on record of a baby which weighed 24 pounds. Therefore, it is to be expected that, during intra-uterine life, the sizes will also vary.

I presented this paper with the thought that it might stimulate the efforts of others who may be more competent than I to carry on this work until the radiographic technic is developed, perfected, and standardized so that pregnancy can be diagnosed as early as the fifth week.

COMPARATIVE TESTS ON SINGLE VALVE RECTIFIED AND MECHANICALLY RECTIFIED RADIOGRAPHIC APPARATUS[1]

By CHARLES WEYL, S. REID WARREN, JR., and C. JUSTUS GARRAHAN,
PHILADELPHIA

Abstract.—This paper discusses the advantages and disadvantages of single valve rectified *versus* mechanically rectified radiographic apparatus. Conclusions are presented which should aid the roentgenologist in choosing such apparatus.

INTRODUCTION

When portability, small space, and low original cost are important factors, radiographic apparatus of nominal rating (100 peak K.V., 100 ma.) is in demand.

The tests reported in this paper were made on a single valve apparatus, rated at 100 K.V.P., 100 ma., and a double disc mechanically rectified machine of the same rating, both products of one manufacturer.

The conclusions drawn are based upon considerations of fundamental design irrespective of differences in methods of manufacture. This is justified, since, in all tests made in this laboratory[2] of practically all such apparatus manufactured in this country, no exceptions to the conclusions stated in this paper are indicated.

The following fundamental characteristics of the two machines were compared:

1. Magnitude of supply current to X-ray machine.
2. Power dissipated by anode of X-ray tube.
3. X-ray tube cathode current.
4. Radiographic density.
5. Reproducibility of results.
6. Original and maintenance costs.
7. Miscellaneous.

[1]These tests were conducted in the laboratories of the Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, under a research grant by the National Tuberculosis Association.

[2]Data for these tests are on file at the Moore School. For detailed description of methods refer to C. Weyl, S. R. Warren, and F. M. McPhedran: Methods of Measuring and Recording Roentgen-ray Tube Currents and Voltages. Am. Jour. Roentgenol. and Rad. Ther., December, 1931, XXVI, 871-877.

C. Weyl and S. R. Warren: A Comparative Photometric Densitometer for the Measurement of X-ray Film Densities. RADIOLOGY, November, 1931, XVII, 946-951.

DATA AND ANALYSIS

Throughout this section the following notation will be employed:

SV—Single valve rectified X-ray apparatus with manufacturer's rating of 100 K.V.P., 100 milliamperes (Fig. 1).

M—Double disc mechanically rectified apparatus with manufacturer's rating of 100 K.V.P., 100 milliamperes (Fig. 2).

1. Magnitude of Supply Current to X-ray Machine.

A non-inductive resistance was used for secondary load. By referring to Table I, it is seen that *SV* draws almost twice as much line current as *M* for a given output (secondary kilovolts and milliamperes). In other words, the primary power factor of *SV* is very low compared with that of *M*. This is due to the fact that *SV* provides half wave rectification while *M* provides full wave rectification.

The heavy current drawn by *SV* causes greater voltage drops and heat losses in the line and control apparatus than are noted in *M*, working at the same secondary kilovolts and milliamperes. This lower power factor serves no useful purpose.

2. Power Dissipated by Anode of X-ray Tube.—Figure 3 shows the X-ray tube currents for *SV* and *M* for the same *average values*. For the same X-ray tube milliammeter reading, the maximum tube current for *SV* is 50 per cent more than the maximum for *M*.

The heat produced by the current flowing through the anode of the X-ray tube is proportional to the r.m.s. (root-mean-square) value of the tube current. From the data given in Figure 3, it is seen that, for a given technic of exposure, the heat dissipated at

the X-ray tube anode using *SV* is about 14 per cent greater than for *M*. This shortens the life of the X-ray tube and serves no useful purpose.

3. X-ray Tube Cathode Current.—The current through the X-ray tube at peak kilovoltages used in radiographic work varies as a complicated function of the cathode temperature. To obtain high values of tube current, this temperature must be increased by raising the value of the cathode heating current. Referring again to the data given in Figure 3, it will be seen that a cathode heating current of 7.15 amperes will be required for *M* to deliver an average current of 200 milliamperes. In order that *SV* deliver the same average current, it is necessary to raise the cathode heating current to 7.70 amperes. If the X-ray tube with this cathode heating current of 7.70 amperes were reconnected to *M*, the average tube current would be considerably greater than 200 milliamperes.

It is, therefore, evident that much higher cathode heating currents are necessary for the operation of X-ray tubes with *SV* apparatus than *M* apparatus. This further shortens the life of the X-ray tube.

4. Radiographic Density.—Photometric densities of radiographs through 0.5 inch aluminum taken with the same film, screen, and technic on both *SV* and *M* machines show slight advantage for machine *M*. Throughout the radiographic range the density difference is less than 10 per cent.[3]

5. Reproducibility of Results.—In order to take reproducible radiographs in less than one-tenth of one second, a synchronous timer is necessary. The recent increased use of the ballistic milliampere-second meter for calibration and for exposure check has substantiated this statement. In the particular case of the *SV* machine controlled by a synchronous timer, there is a further difficulty which prevents reproducibility of results on exposures of less than 0.1 second. In such short exposures, the final radiographic effect is dependent upon the particular alternate half-cycle at which the synchronous timer happens to close the primary circuit. This is dependent upon the phase at which the synchronous timer motor is started with respect to the X-ray apparatus supply current. A brief discussion of this phenomenon follows.

TABLE I.—PRIMARY INPUT AND SECONDARY OUTPUT FOR BOTH MACHINES

Machines	Secondary peak kilovolts	Secondary milli-amperes	Supply line voltage (volts)	Supply line current (amperes)	Input kilowatts	Input power factor (percentage)
M	80	100	232	41.5	9.0	93.5
SV	80	100	232	83.0	9.6	50.0
M	100	100	232	49.8	10.9	94.4
SV	100	100	232	100.0	11.1	48.0

Oscillograms of X-ray tube voltage and current of exposures made with *SV* apparatus are shown in Figure 4. It will be noted that, during the two exposures, the measured peak voltage and milliampere-seconds remained virtually the same. However, the photometric density of a film exposed with screen at 70 inches focal film distance through 0.5 inch of aluminum was 0.84 for the exposure marked Figure 4-*A*, and 0.73 for the film marked Figure 4-*B*. The difference is accounted for by close examination of the oscillogram (Fig. 4-*B*). A pulse of current is recorded at the end of the exposure with practically no voltage recorded at the same time. This pulse of current, measured from the oscillogram, has a value of 1.2 ma.-sec., which is 11 per cent of the total exposure. This pulse was not

[3] F. W. Bishop and S. L. Warren: A Comparison of the Efficiency of Valve Tube and Mechanically Rectified Roentgenographic Machines. Am. Jour. Roentgenol. and Rad. Ther., March, 1929, XXI, 229-240.

agent to the production of useful X-rays. The oscillogram (Fig. 4-*A*) shows no pulse. In this case the reading of the milliampere-second meter indicates the quantity of electricity used to produce X-rays. The difference in density of the radiographs is shown in the following data.

The direct cause of this phenomenon may be seen by examining the oscillograms in Figure 5. If the synchronous timer is adjusted so that the last half-cycle of the exposure has the polarity for which the valve blocks current, then there will result a pulse of current in the X-ray tube circuit at the

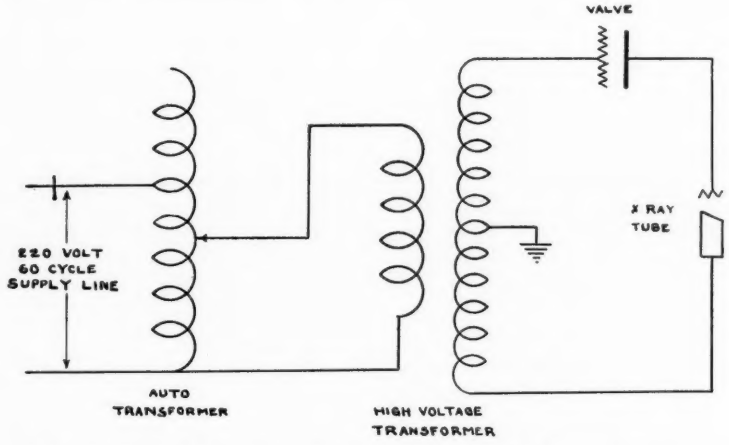

Fig. 1. Simplified circuit of the single valve rectified X-ray apparatus.

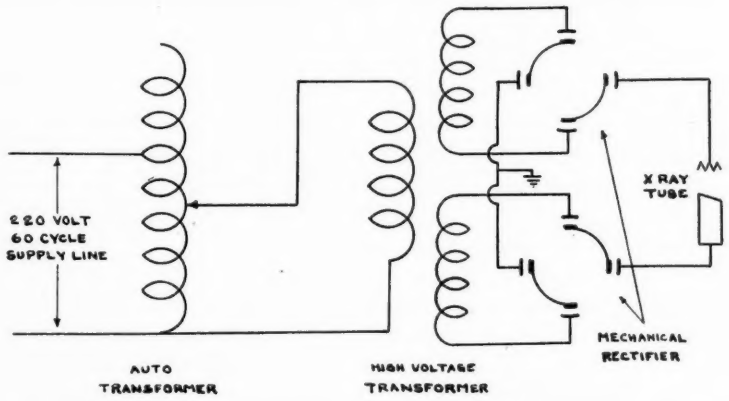

Fig. 2. Simplified circuit of the double disc mechanically rectified apparatus.

	Apparent quantity	Useful quantity	Voltage	Density
Figure 4-*A*	10.6 ma.-sec.	10.6 ma.-sec.	80 K.V.P.	0.84
Figure 4-*B*	10.8 ma.-sec.	9.6 ma.-sec.	80 K.V.P.	0.73

(1.2 ma.-sec.—quantity represented by pulse—not useful.)

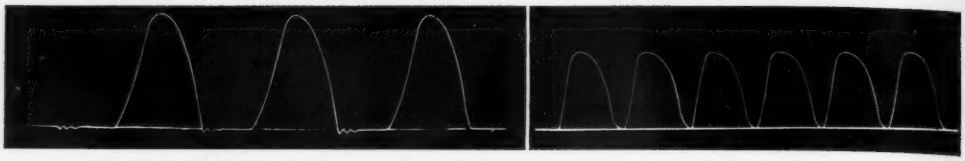

Fig. 3-*A*. *SV*

Average X-ray tube current	200 milliamperes
Peak X-ray tube current	492 milliamperes
Root-mean-square X-ray tube current	269 milliamperes
X-ray tube cathode heating current	7.70 amperes

Fig. 3-*B*. *M*

Average X-ray tube current	200 milliamperes
Peak X-ray tube current	332 milliamperes
Root-mean-square X-ray tube current	236 milliamperes
X-ray tube cathode heating current	7.15 amperes

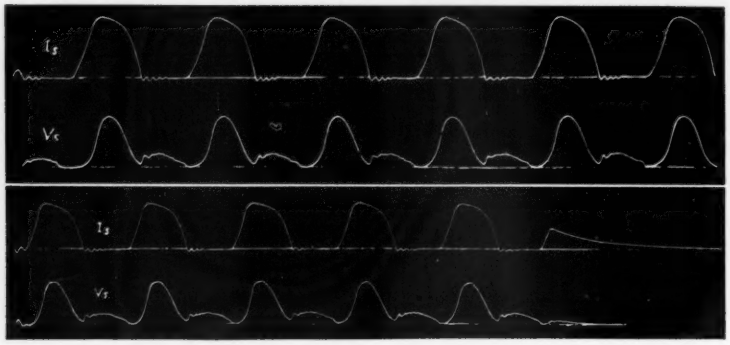

Fig. 4-A *(top)*. X-ray tube peak voltage—80 K.V.P. Exposure—10.6 ma.-sec. Timer setting—12 half-cycles (0.1 sec.).

Fig. 4-*B (bottom)*. X-ray tube peak voltage—80 K.V.P. Exposure—10.8 ma.-sec. Timer setting—12 half-cycles (0.1 sec.).

(The first half-cycle is omitted to provide for space requirements)

V_s—X-ray tube voltage

I_s—X-ray tube current

end of the exposure which contributes to the reading of the milliampere-second meter but *not* to the useful X-ray output. If the last half-cycle of the exposure has the polarity for which the valve passes current, then the ballistic meter reads the quantity of electricity used to produce useful X-rays.

The extra secondary pulse is believed to be caused by the dissipation of energy stored in the transformer core by the transient primary current. This theory is supported by the fact that the longer the exposure the less pulse results at the end. It is clearly seen that the primary current is a transient uni-directional current during the first one or two cycles, slowly building up to a steady state alternating current. After the steady state is established (roughly one-tenth of a second) the primary may be broken at any point of zero current without inducing an extraneous pulse in the secondary.

However, the important fact is established: comparable radiographs, with exposures less than one-tenth of a second in duration, cannot be made with *SV* apparatus. This must be considered, particularly if stereoscopic pairs are desired.

6. Original Cost and Maintenance Cost.—The average original cost of *SV* apparatus is about $300 more than for *M*. The maintenance cost should be approximately the same with either type, though the very material cost of valve replacement must not be overlooked.

7. Miscellaneous.—*SV* has the advantage of operating more quietly and has, of

course, no moving parts. Space requirements are approximately the same for *SV* and *M*.

It is well known that X-ray apparatus with mechanical rectification produces radio interference. It is important to state that *SV* also causes radio interference, due to the transients produced by half-wave rectification.

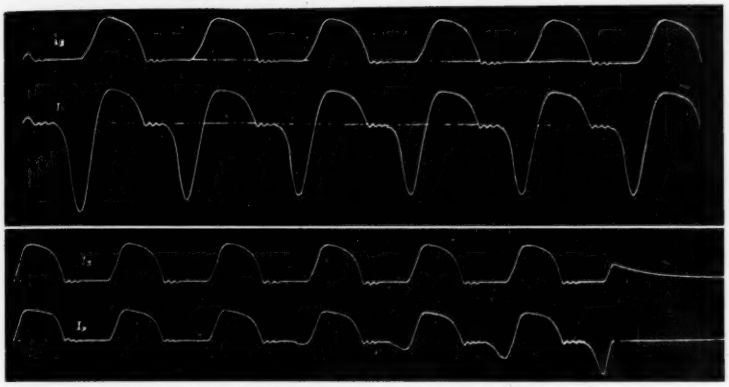

Fig. 5-*A (top)*. Last half-cycle of exposure has polarity for which valve passes current.

Fig. 5-*B (bottom)*. Last half-cycle of exposure has polarity for which valve blocks current.

I_s—X-ray tube current

I_p—High voltage transformer primary current

SUMMARY AND CONCLUSIONS

Opposed to the sole advantage of quieter operation, the single valve radiographic apparatus offers many serious disadvantages:

1. With a given exposure technic and supply line, the voltage drop and power loss in the supply system is nearly twice as great for single valve apparatus as for mechanically rectified machines.

2. At a given exposure technic, at least 15 per cent more power must be dissipated at the anode of the X-ray tube operated by single valve rectification, though the radiographic output is the same as that of mechanically rectified machines. Tube life is shortened by this extra heating.

3. For a given average X-ray tube current, the cathode must be operated at a higher temperature with single valve rectification. Tube life is further shortened.

4. Because of peculiar transient currents in the primary circuit of a machine with single valve rectification, radiographic results cannot be accurately reproduced, if short exposures are necessary.

5. The original cost of single valve apparatus is higher than the corresponding cost for mechanically rectified machines.

REPORTS OF ROENTGEN FINDINGS[1]

By I. S. TROSTLER, M.D., F.A.C.R., F.A.C.P., CHICAGO

I BELIEVE that every member of this Section is cognizant of the fact that at the present time the position and reputation of the medical profession in the eyes of the public is unsatisfactory. We are being investigated by committees, made the butt of jokes and gibes, the objects of criticism and sarcasm by the press, the judiciary, and the public, and, as radiologists, even by our professional brothers in other medical specialties.

One of the reasons for this latter complaint and fault-finding by our professional brothers is an apparent disregard for minutiæ and detail—probably not so much in our observations and examinations, as because of the inadequacy and apparent superficial character of the reports of examinations rendered by radiologists to referring physicians.

I do not believe that any of you will deny that nearly all of the reports and findings in roentgen examinations are incomplete, inadequate, and too brief to permit of statement as to what is or is not found.

Our late-lamented and highly revered confrère and co-worker, Preston M. Hickey, called our attention to this matter some years ago and some of us are reminded and remind others of it frequently in medical meetings and elsewhere.

There is nothing that will increase the respect and esteem of competent radiological diagnosis in the minds of referring physicians as will reports indicating that an intelligently directed, complete and thorough study has been made, and that the various aspects of the case or lesion have been given careful consideration. The better informed the referring physicians are, the more will a competent and detailed report be appreciated.

What is more unsatisfactory than to see a report stating, "Examination of the ankle is negative"? I have in my files such a report made by a radiologist of national reputation and standing.

We have repeatedly asserted that we are consultants and insist that we should be considered as such by those who refer patients to us. Most of us have been in general practice before becoming radiologists—specialists—and the wise ones still keep closely in touch with all the advances of the general medical profession and try to keep up to date with our end of all the specialties as well. A consultant, when called to see a patient with any obscure disease or illness, is expected not only to be able to render an opinion and give advice, but also to explain the basis of his opinion and his reasons for giving the advice. So we must back up our diagnosis by explaining our findings, and we can do no better in furtherance of that aim than by relating our findings in detail to the referring physicians, and then giving a summary of the findings. We can give a diagnosis and when deemed advisable, discuss the treatment as well. This latter is often of great importance in fracture cases, particularly if we are called upon to examine fractures after the adjustment of fragments, or during the healing process.

It has been said that a diagnosis can seldom be made by roentgen examination alone, but I take issue with that statement and am ready to say that a diagnosis can be made after a roentgen examination alone as often as after any other single method of examination. Besides this, as clinicians we should give the referring physicians the benefit of our knowledge when

[1]Presented before the Section on Radiology of the American Medical Association at Philadelphia, June 12, 1931, and by unanimous consent released from publication in the *Journal of the American Medical Association.*

they want it and the best way we have of informing them that we have that knowledge is by showing it in our reports. I am not advocating that we force them to listen to our opinions, but if our experience is of any value we should not be chary of giving it, and the better class of referring physicians—the ones who are really worth while to work with—will be glad to benefit by our experience, advice, and opinions. By this means we can make our services so valuable that lay technicians will not be thought of in the same week as ourselves.

Everything in medicine must revolve around the patient and how best to serve him. For that reason, all the information we can give the referring physician regarding the physical condition of his patients, as revealed by our findings, is valuable, and, because of this, value should be delivered to the physician who is responsible for care and relief of the patient.

Roentgen findings are understandable only by those who have made sufficient study of them to know what variation from normal, if any, exists. So that, in addition to reporting what we have found, it is frequently very important that we report some of the things that we do not find, and then summarize and interpret our findings in terms used in ordinary medical parlance.

Granting that the foregoing is true, I will try to show what, in my opinion, reports of roentgen examinations should contain.

Reports of examinations of teeth should mention if any of the following conditions are present or *absent:* Alveolar absorption, indistinctness of apices, caries of teeth, abscesses; if present, describe pericementitis, excementosis, cysts; if present, describe fractures of teeth or roots, deciduous teeth, malposed, unerupted, impacted, or supernumerary teeth, perforated roots or other pathology, irregularities or anomalies, stone in salivary duct.

Reports of examinations of the nasal accessory sinuses should include the presence or absence of departures or variations from normal in the frontal sinuses, superior maxillary sinuses, ethmoid cells (specifying groups), sphenoidal sinuses, orbital cavities, nasal fossæ, variation from normal in thickness, density, or symmetry; fractures, newgrowths, anomalies, foreign bodies.

Reports of examinations of the thorax should mention both normal and pathologic findings in regard to the heart size, position, and contour; broadening, pulsation, etc., of aorta; the mediastinum; particulars regarding the lungs, itemizing obstructions, cavitation, and other changes in the apices, parenchyma, and lung fields, bronchial shadows, hilar shadows, glands, etc.; of the pleura as regards adhesions, thickening, fluid, pneumothorax, etc.; of the diaphragm regarding respiratory excursions, angles, herniation, eventration, etc.; of the ribs and bony framework, anomalies and deformities.

Reports of examinations of the gastrointestinal tract should itemize both normal and pathologic findings regarding location of tumors and areas of tenderness; the character of filling, outline, contour, peristalsis, size, position, emptying, filling defects, foreign bodies (if present), etc., of stomach; the size, position, contour, etc., of the duodenum; the caliber, passage of meal, delay, diverticulation, etc., regarding the jejunum; the time of receipt of meal, size, caliber, diverticulation, filling defects, tonicity, adhesions, delay, etc., regarding the ileum; the time of receipt of meal, size, position, location, tonicity, filling defects, adhesions, delay in emptying, etc., of the cecum; whether seen or not (if tender), emptied or not, angulated, kinked, adherent, position and size of appendix; position, size, contour, tonicity, haustration, filling defect, redundancy, diverticulation, emptying, etc., of the colon and sigmoid.

Reports of examinations of the gall bladder should state manner in which the dye was administered, degree of filling of the

viscus, concentration, emptying, deformity, shadows of stones (or not), and a detailed explanation of the meaning of the findings.

Reports of examinations for fractures or dislocations should state if stereoscopic examination was made, or if a comparison with the opposite part was made and if fracture or dislocation is present. If fracture is present, the exact anatomical location in inches or centimeters from a bony landmark, and whether simple, complete, greenstick, comminuted, multiple, diastatic, spiral, impacted, oblique, transverse, longitudinal, stellate, T-shaped, depressed, elevated, etc. If fragments are displaced, state whether inward, outward, distally, proximally, angulated, over-riding or other anatomical position. State whether or not callus is present. If dislocated, state direction of dislocated portion, naming bony landmark as guide. State whether or not bones are of normal density; whether tumor, cyst, or other pathologic change is present; anomalies, etc.

Reports of other examinations should be in similar detail, as a general rule and only under exceptional conditions should brief, concise reports be rendered.

It must be admitted that apparently the making of such reports will consume much time, but this is more apparent than real, and, as a matter of fact, after practice they can be made quickly if systematically done. In instances in which a very large volume of work is done, such reports as these cannot be made routinely, but they should be prepared, even then, in the more important cases.

The future of radiology as a specialty depends largely upon the radiologists of to-day who stand out as real specialists; who know and are able to tell more about the subject than can any others. It is by showing the general practitioners, other specialists, and all those who refer patients for roentgen examinations that we do know and can tell more than they know, can see, or find out for themselves that our specialty will continue as such and the men now entering it will not find themselves "without home or heritage."

An enormous amount of miserably poor X-ray work is being done by general practitioners (and others) who have been induced by the beguiling talk of salesmen to purchase apparatus. These men are trying to make use of their outfits and are often groping around, trying to interpret their films and make diagnoses. Many of the more conscientious of these send films to experts for interpretation and diagnosis. We frequently have letters marvelling at how much we are able to tell them from their ofttimes poor quality films. This is the rule rather than the exception and by our rendering full and complete reports of our findings we will be able to impress the importance of our specialty in the most forcible manner, and elevate our standing above what a few still consider us to be, namely, medical photographers.

I realize that I have told you nothing new, but I trust that I have stimulated or roused a few of you into making more complete reports of roentgen findings.

THE BEHAVIOR OF AIR-COOLED X-RAY TUBES OPERATED ON TRANSFORMERS WITH VALVE TUBE RECTIFICATION AND CONDENSERS[1]

By ERNST A. POHLE, M.D., PH.D., Professor of Radiology, University of Wisconsin
MADISON, WISCONSIN

DURING the past five years, the development of X-ray apparatus has exhibited a definite tendency towards the use of valve tube rectification. While on the Continent nearly all manufacturers have discontinued building mechanical rectifiers, this change is taking place much more slowly in America. There are relatively few institutions in this country operating equipment of this newer type, and, as far as the writer knows, no data have been made available concerning the behavior of air-cooled Coolidge tubes on American-made X-ray generators using hot cathode valve tube rectification. From the many inquiries received during the past three years, it seems logical to assume that there exists a considerable interest among roentgenologists regarding the performance of valve tube apparatus. Our own experience in the Department of Radiology and Physical Therapy at the University of Wisconsin dates back to the Fall of 1928, and since detailed records were kept as to the output of the equipment, the life of the valve tubes and of the X-ray tubes, we will publish these data in this paper with the hope of assisting others in forming an opinion concerning some of the characteristics of that type of equipment. The figures presented here refer to therapy machines exclusively, with valve tubes and condensers in the circuit. It is emphasized that no attempt whatsoever has been made to investigate the respective merits of valve tube and mechanical rectification, nor do we wish to endorse the particular make of equipment employed by us. As a matter of fact, the possibility of such a misinterpretation led us to question the advisability of publishing this report. However, we felt that an institution is under a definite obligation to render its experience accessible to the profession, and it may be assumed that the observations made on one X-ray generator with valve tube rectification and condensers holds for any other similarly constructed machine with the same amount of rippling.

In compiling the available data we were guided by practical considerations only. They will deal, therefore, with the tube life, with variations of the output during the day, and over the entire useful period of a tube. Comparative figures for different types of air-cooled X-ray tubes are also presented.

TECHNICAL STUDY

Two therapy machines were available for this study; one had four valve tubes and condensers to deliver a maximum of 300 K.V., the other two valve tubes and condensers to deliver a maximum of 140 K.V. The tube connected to the first apparatus is placed in a lead drum with a fan increasing the circulation of the air. On the second generator we have been using a Metalix therapy tube provided with thermosiphon water-cooling.

The output of the apparatus is determined at every 50 hours of tube life, *i.e.*, a complete calibration over a range of six qualities of radiation is carried out. Numerous checks are made at shorter intervals for intensity only. The measurements were done with a Siemens dosimeter, a Wulf ionometer, the latter having been calibrated at the Bureau of Standards, and a Victoreen instrument. For the presentation of the data in this paper we have chosen for each

[1]Read at the Annual Meeting of the Radiological Society of North America, at St. Louis, Nov. 30–Dec. 4, 1931.

generator one quality of radiation only, namely, a beam produced at 160 K.V.[2] and filtered through 0.5 mm. Cu + 1.0 mm. Al and one at 100 K.V.,[2] filtered through 1.0 mm. Al. This simplifies the charts and reduces their number. In Figure 1 the fluctuations of the output during one day, or 8 hours, of more or less continuous performance are presented; readings were taken over a period of 20 minutes at 9:00 A.M., 2:00 P.M., and 4:00 P.M. In Figure 2 we have combined the data on all tubes used during the past three years. The first eight tubes were of the same type, while the ninth and tenth tubes represent two other makes. In order to bring out the variations between the different tubes, the output of each has been averaged for the entire tube life and this value has been indicated on the chart. The average output of all ten tubes over their entire lives is represented by a horizontal line. The data for the quality of radiation are shown in an identical manner.

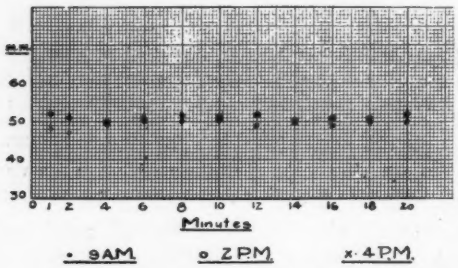

Fig. 1. Output of tube No. 10 operated at 180 K.V., 6 ma., 0.5 mm. Cu + 1.0 mm. Al. The ordinate indicates the deflections of the galvanometer in millimeters (Siemens dosimeter).

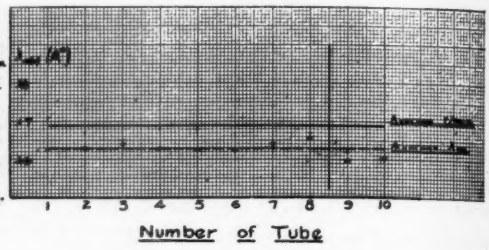

Fig. 2. Average quality (λ eff.) and quantity (r) of radiation emitted by 10 therapy tubes operated at 160 K.V., 0.5 mm. Cu + 1.0 mm. Al. Tubes Nos. 1–8 are of the same type; tubes Nos. 9 and 10 represent two different types. The effective wave length was determined according to Duane's method by adding 1 mm. Cu.

DISCUSSION

Before analyzing the figures presented above it might be worth while to say a few words concerning the operation of the tubes. Most of our work on the four-valve-tube rectifier was done at from 160 to 180 K.V. We found it impossible to run the air-cooled tubes at 200 K.V. for any length of time because they punctured so fast that the procedure became far too costly. Spectra taken at the positions 160 and 180 K.V., respectively, on the pre-reading kilovoltmeter showed the actual potentials to be approximately 145 and 170 K.V. as determined from the minimum wave length (See Fig. 3). The corresponding half value layer in copper amounted to 0.82 and 0.94 millimeters. Consulting the tables published by Grebe and Nitzge,[3] we found that this would indicate tube potentials of 160 and 180 K.V., respectively. Absorption curves in

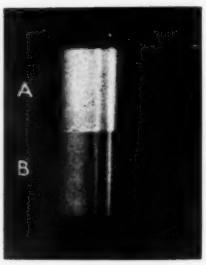

Fig. 3. Spectrum taken at 160 K.V., 4 ma., with Seemann spectrograph *(a)*. Spectrum taken at 180 K.V., 4 ma., with Seemann spectrograph *(b)*.

[2] Taken from pre-reading kilovoltmer, calibrated at the factory.

[3] L. Grebe and K. Nitzge: Tabellen zur Dosierung der Roentgenstrahlen, Berlin, 1930, p. 19.

Al (100 K.V.) and Cu (160 and 180 K.V.) are also shown (Figs. 4 and 5). In order to assure long tube life it is advisable to start the tubes at no higher than 100 K.V. peres. This tube has operated so far most satisfactorily at 180 K.V. and 6 ma.; however, our experience is too limited to justify the writer in offering final conclusions.

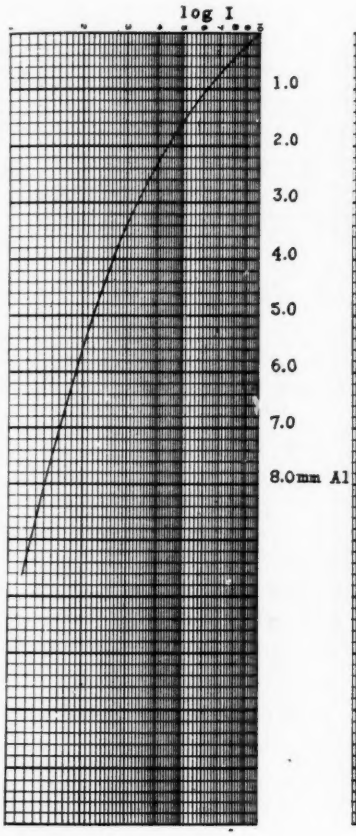

Fig. 4. Absorption curve in aluminum (100 K.V., 4 ma.).

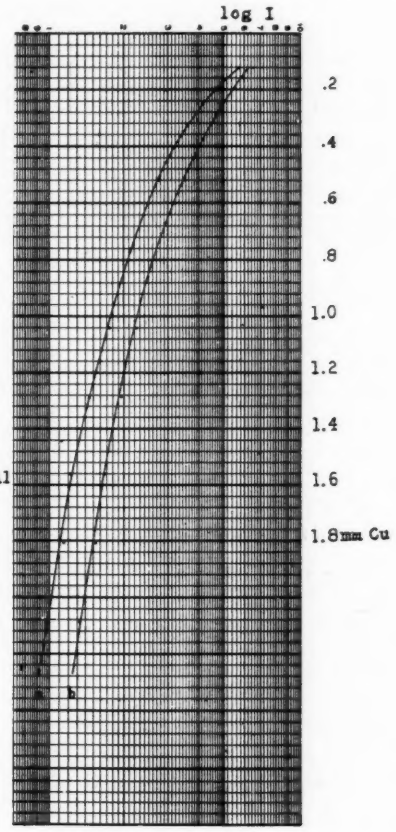

Fig. 5. Absorption curves in copper for 160 K.V. *(a)* and 180 K.V. *(b).*

and 2 ma. and work up slowly to the desired potential. At the end of the treatment it is suggested that both potential and current be lowered to the initial value before opening the transformer switch. Most air-cooled tubes cannot—at least, in our experience—be operated at higher currents than 4 or 5 ma.; however, a new model has been brought out recently (See Table I, No. 10) built to tolerate 200 K.V. at 10 milliam-

The valve tubes have given very little trouble; during three years of operation only one out of six has had to be replaced. It is necessary to test the filament current at definite intervals so as to avoid under- or over-heating of the filaments, and improper function of the kenetrons. A simple, practical indicator is the temperature of the valve tube anode; if one out of a set of several appears to be at a higher temperature

TABLE I.—SURVEY OF 10 TUBES

Data based on measurements at 160 K.V., 4 ma., 0.5 mm. Cu + 1.0 mm. Al, 50 cm.; half value layer in Cu = 0.82 millimeters.

Tube	0 hr. r/min.	50 hr. r/min.	100 hr. r/min.	150 hr. r/min.	200 hr. r/min.	250 hr. r/min.	300 hr. r/min.	Tube life in hr.
1.	8.4	8.1	7.9	8.0	....	....	....	163
2.	7.4	7.9	7.9	7.0	8.1	....	....	215
3.	7.5	....	....	....	....	....	....	44
4.	7.6	8.0	....	....	....	....	....	54
5.	7.6	7.8	7.4	8.0	8.1	....	....	235
6.	8.1	7.5	7.8	7.3	8.0	7.6	7.9	322
7.	8.4	8.4	8.4	8.6	8.1	....	....	208
8.	8.2	7.8	7.1	7.2	8.1	still running		.....
9.	7.4	6.7	7.1	6.9	7.8	....	....	220
10.[4]	9.3	9.0	9.2	9.1	still running		....	.....

[4]At the time this report was written, this tube had punctured after a total running time of 360 hours.

when touching the anode end of the bulb, the filament current usually needs adjusting. A red-hot anode, of course, must be regarded as a danger signal.

A study of Table I shows that, with a few exceptions, one may expect an average tube life of at least 200 hours for deep therapy conditions. The quality and the quantity of the radiation even for different tubes of the same type vary within reasonable limits (Fig. 2); the same holds true of the daily fluctuations (Fig. 1). This facilitates, of course, a dosage according to time of exposure using a previous calibration in r as basis. The accuracy of that method is entirely dependent on the steadiness of the output. It is noted that tubes No. 9 and No. 10, representing two different types, show more deviation from the average figures established for the other eight tubes, which are all of identical construction.

The advantage of using "overrated" tubes is clearly demonstrated in the data obtained with the Metalix tube (Table II) built for a maximum potential of 140 K.V. but operated on 100 K.V. and 4 milliampères. It has run for nearly a thousand hours during a two-year period and is still functioning well.

TABLE II.—OUTPUT OF WATER-COOLED METALIX TUBE

Data based on measurements at 100 K.V., 4 ma., 1.0 mm. Al, 30 cm. half value layer in Al = 2.4 millimeters.

Date	λ eff. in Å.	r/min.
7-25-1929		29.5
1-18-1930		31.8
2-26-1930	average	31.8
2- 9-1931	0.38	31.6
4-21-1931		31.2
7- 6-1931		30.0
11-16-1931[5]		29.4

[5]Total running time approximately 1,000 hours.

SUMMARY

1. Detailed records were kept over a period of three years concerning the quality and quantity of radiation emitted by ten air-cooled Coolidge deep therapy tubes operated on X-ray apparatus with valve tube rectification and condensers; and also by one water-cooled Metalix tube used for skin therapy.

2. Data are presented showing the fluctuations of the output of the apparatus *(a)* for one tube during the day, *(b)* for all tubes during the entire tube life.

3. It is hoped that other radiologists will follow our example in publishing their experience with valve tube apparatus in order to permit final conclusions as to its merits. After all, it is not so much the laboratory experiment but the behavior un-

der conditions existing in daily practice which will decide the question.

DISCUSSION

E. C. ERNST, M.D. (St. Louis, Mo.): The discussion of X-ray tube life problems is especially significant since the methods and types of rectification have recently undergone radical changes. Occasionally someone reports unusual "long tube life" and this result could be due either to a well pumped tube or to the probability that the potential employed in daily use was far below the full capacity of that particular X-ray tube.

Therefore, I think Dr. Pohle's remarks with reference to "favoring" the X-ray tube by employing a potential definitely lower than the official rating point the way to an economical factor of great importance and a good rule for the average radiologist to follow.

I found that the kilovolt rating of some of the early European tubes appeared to be greater than they should be, but the recent ones were more than satisfactory. When planning to employ 180,000 volts, I would prefer a tube that has a rating by the manufacturer of from 225,000 to 250,000 volts.

This whole problem is difficult to analyze because, first of all, we are not always speaking the same voltage or potential language but at random are comparing different types of mechanical valve tube and other rectified outfits.

Many of those radiologists who believe they are actually employing 200 K.V. in their treatment work are perhaps using a much lower comparative voltage effect. I do know that when the 200,000 K.V. mechanically rectified units at from 25 to 30 milliamperes are carefully checked the minimum wave length measurements may be extremely low, even though the sphere gap measurement of voltage is relatively high. Therefore, Dr. Pohle's figures compare favorably with the average except that during the past year our X-ray tubes have been improved. These tubes are not mysterious gas bulbs but they are temperamental and it is largely a matter of taking good care of them and especially taking care to avoid overloading.

I do hope that the day of "gassy tubes" is over. Every manufacturer should strive to eliminate gas in even new tubes because by so doing he certainly increases the life of the tube as well as favors a smooth, non-fluctuating flow of X-ray.

In therapy work, as you increase your voltage, a careful check should be noted as to the relative milliamperage variation in the X-ray r output per minute. If you increase the voltage beyond this point of smooth working, it will decrease your tube life.

Several things should be remembered as essential to promoting tube life. In the first place, you must carefully check your tube and decide whether or not you have a good stable tube with little or no evidence of gas. You must compare the actual voltages and give due consideration to the type of rectification employed. If you are not overloading your tubes and still have trouble, there may be something wrong with the rectification you are employing, whether mechanical or valve tube type. The possibility of incorrect valve tube heating or unbalanced cross-arms or disc contacts must be given due consideration. Valve tubes require careful consideration since they are not fool-proof.

Dr. Pohle's paper is one that is timely and reasonably clarifies the atmosphere relative to statements frequently made in an attempt to show that the present-day valve tube systems are "hard" on X-ray tubes.

That the present improved type of valve tube rectification does reasonably give us a more uniform and more reliable voltage is incontrovertible, and, therefore, the end-results in our treatment work should correspondingly be improved by their use.

ARTHUR MUTSCHELLER, Ph.D. (New York City): Every one connected with X-ray therapy problems ought to be glad that Dr. Pohle has made these figures available; I believe you will agree with me that there is a considerable difference between the tests for performance in the laboratory and the actual tube performance out in the clinical therapy institute.

Dr. Chamberlain has pointed out correctly that to-day we hear so much about different kinds of voltage values which, if compared on the basis of actual and effective voltages, will lead us completely astray. In the face of such difficulties, it is absolutely necessary to be careful so as not to be led to form erroneous conclusions.

All that has been said here so ably could perhaps be summarized in sort of a formula, in this way: The tube life is actually related to the load upon the tube, perhaps in the way that the product of tube life times current energy load gives a constant value. If tubes are rated in a laboratory and the highest possible load is given, this does not mean that the tube can be operated with that load indefinitely, but it means that the maximum load which the tube can stand is for a comparatively short life time. If we take the same tube and operate at a lower load, its useful life will proportionally be increased. Nothing can be more erroneous than to select a tube with the expectation that it will run at its highest rating and perform well for a very long time.

There is perhaps a certain tendency, based on competitive reasons, to make tube ratings as high as possible. If manufacturer A will give us a high rating, then manufacturer B feels he cannot afford to be lower; so tube ratings, as given in catalogs, must be interpreted on the basis of this principle. But we are always coming back to the same rule, that the load multiplied by the tube life will give a constant value, or if a tube is operated at its maximum load, its life will be short; on the other hand, a tube, if operated below its maximum load, will have its life increased in that proportion.

We should be glad to have these figures available and we should appreciate very much having more such data presented.

Dr. H. B. Podlasky (Milwaukee, Wis.): Dr. Mutscheller's remarks prompt me to say that there should be some law or courtesy act on the part of the manufacturers to definitely state these conditions to the prospective buyers who are not in a position to do what you gentlemen might easily do if given a chance. Of course, the advertising laws are pretty strict in some sections, and the statements made relative to performance of a product are better than they have been. That should apply to X-ray machines.

You will agree with me that in a great many instances the radiologist is not in a position to keep constantly abreast of new equipment, and the salesmen, very fortunately, have a field outside of radiology where they find people with enough money to buy their machines. The prospective buyer probably knows much less than the radiologist who cannot afford to buy it.

I really feel there should be some compelling feature in this situation.

Dr. A. Jerome Thomas (Shreveport, La.): I would like to ask the essayist, or some of the discussants, if they will answer a question in regard to valve tube rectification. Have they had any experience as to tube mortality of the constant filtered potential which has apparently a terrific mortality?

I come from the South and would probably operate under different conditions and do not reach the higher output problem of mechanically rectified units that you reach in higher altitudes. There have been some installations made in Louisiana of this high powered constant potential valve tube rectification. I am not interested from the commercial standpoint except as a prospective purchaser, and I am asking, along the line suggested by the Chairman, for an honest-to-goodness answer, if it is possible to get it.

I shall not mention the manufacturers. There are three in that line of production who are most prominent. I have in mind two radiologists who are pioneers, so that there cannot be any lack of knowledge of control or anything like that. One doctor, operating at 100 K.V.P., with constant potential, had his tube punctured very promptly, and had to replace it. Another was in one of the largest institutions of the South. The electrical engineer, investigating that, told me there was a defect in installation.

There is, of course, no doubt but that there is an advantage in the valve tube rectification over the old type of mechanical rectification. If you were to make comparisons between the

life of your tube under conditions of measuring your r-unit production and that sort of thing, and give us some future data of the tube mortality, with your constant filter eliminated from the apparatus, I think it would be very helpful. You may get the same tube life from your valve tube that you got from the mechanical unit. You may not get the tube mortality. If that can be answered by the people using valve tube rectification, 200 or 230 K.V. capacity, without the condensers in the circuit, I would like to know what the tube mortality is with that type of equipment.

DR. E. A. POHLE (closing): All of our tubes punctured at the end of the period stated in Table I, most of them in a spot so small that it was difficult to detect. In one instance, we could not find it; nevertheless the tube showed extreme fluorescence and there was such a high current going through that there could be no doubt about its being punctured.

I am glad Dr. Chamberlain mentioned the experience of the physician using 200 K.V. actually measured by the spectrograph. We tried the same thing, but the tubes, which had run about 30 hours at lower potentials and then were placed at 200 K.V., simply exploded. We were running the air-cooled type in a lead cylinder; suddenly there was a terrific crash and the cylinder was full of glass pieces. Therefore, under present conditions, I would not advise the operation of an air-cooled tube, on a constant potential machine, at 200 K.V. as determined by the minimum wave length.

Stomach Ulcer Heals like Skin Irritation.—"There is at present no one best way of treating peptic ulcers either medically or surgically," declared Dr. Frank C. Mann, of the Mayo Clinic, in a symposium held on this often fatal and always disabling and distressing condition. Dr. Mann reported to the American Medical Association studies which he and Dr. Jesse L. Bollman had made on causes and methods of curing ulcers in animals.

The process of healing in an ulcer is the same as that in acute irritation of the skin, they found. Acidity seems to be the chief factor in causing ulcers and in preventing their healing, but the mechanical factor of injury is also important. Ulcers occur most often in the region of the stomach most exposed to acid and against which the stomach contents are thrown with most force in the process of digestion.

The investigations of Dr. Mann and Dr. Bollman showed that it is apparently not one large dose of acid that causes the ulcer, but an exhaustion of the stomach's neutralizing mechanism by continuous presence of acid even in smaller amounts. One short period of excess acid, however, may delay the healing of an ulcer as long as one week. Methods of protecting the ulcer from mechanical injury, and of controlling the amount of acid, promote healing of the ulcer, they found.

The use of mucin, prepared from hog's stomach lining, in treating stomach ulcers was described by Dr. A. C. Ivy and Dr. S. J. Fogelson, of Northwestern University Medical School. This treatment has been used in over four hundred cases during the past two years. The investigators reported that it gives the patients continued relief from their symptoms and enables them to return to work. Dr. Mann and Dr. Bollman, however, reported that while they found it definitely reduced the amount of free acid in their experimental cases, they had not yet been able to heal the ulcers with it.—*Science Service.*

MEDICO-LEGAL DEPARTMENT

LIABILITY FOR ROENTGEN INJURY, AFTER ADMINISTERING 160 APPLICATIONS

By I. S. TROSTLER, M.D., F.A.C.R., F.A.C.P., CHICAGO

FOR illogical ratiocination and reasoning from false premises, this decision by the Supreme Court of Tennessee caps the climax, and, as a natural sequence, the conclusions drawn from such fallacious reasoning can be no less erroneous.

The need for "blood counts in order to determine whether endarteritis was present" is so novel a procedure that we, in our benighted ignorance, have yet to learn about it.

While we prefer not to comment upon or discuss the administration of one hundred and sixty treatments, the fact that the physician was able to keep his patient alive as long as he did, *in the presence of malignancy,* bespeaks at least more consideration at the hands of the plaintiff, the judges on the bench, the jury, and attorneys; but, of course, they knew nothing of that situation. So in the face of this, we call your attention to the case of Casenburg *vs.* Lewis (Tenn.), 40 S.W.R. (2nd) 1038.

In 1918 Mrs. Lewis was operated on for the removal of an abdominal tumor. After the incision had been made, it was decided inadvisable to remove the growth. A diagnosis of inoperable malignancy was made and patient's abdomen was closed. She was sent to Dr. Casenburg for roentgenotherapy, and up to May 5, 1924, he administered a total of 160 treatments. She lived until Jan. 14, 1926 *(nearly 8 years),* suing the defendant for malpractice before that time, because of an alleged dermatitis on her abdomen. The case was prosecuted by her executor.

At the first trial, the court directed a verdict for the physician-defendant. On appeal by the plaintiff the Court of Appeals reversed the cause and remanded it for another trial, and the Supreme Court of Tennessee affirmed that action.[1] The second trial resulted in a judgment for the plaintiff. The Court of Appeals, however, reversed that judgment and again remanded the case to the trial court, because of the failure of that court to direct a verdict in favor of the physician-defendant. The plaintiff a second time appealed to the Supreme Court of Tennessee, which then affirmed the judgment of the trial court in his favor, subject to a reduction in the amount of the judgment.

If the instrumentality that produces an injury, said the Supreme Court, is under the exclusive control of the defendant, and if an injury would not ordinarily result if due care is exercised, the doctrine of *res ipsa loquitur* applies and raises an inference of negligence on the part of the defendant. That inference becomes conclusive unless rebutted by countervailing evidence. When an effort is made to rebut this inference by opposing evidence, the weight of the inference as well as the weight of the explanatory evidence must be determined by the jury, unless uncontradicted explanatory evidence excludes the inference that the injury resulted from want of ordinary care. The trial court, therefore, rightly allowed this case to go to the jury.

At the trial, an undiscoverable idiosyncrasy on the part of the patient, superinduced by the cumulative effect of past treatments, producing endarteritis, was alleged by way of defense; also the negligent use of scarlet red on the itching surface of the abdomen. The physician-defendant and other witnesses testified that the roentgen apparatus used was such as was in common use by other physicians, that it was properly used, and that the roentgen ray was applied properly in respect both to time and intensity in the course of the treatment of May 5, 1924, and of all other treat-

[1]Lewis vs. Casenburg (Tenn.) 7 S. W. (2d) 808.

ments. In the opinion of the physician-defendant, the injury to the decedent was unavoidable.

A medical witness testified that third-degree burns are unusual and attributed them to the following causes: (1) excessive dosage, caused by failure of the roentgenologist to use proper filterage, or by excessive exposure, or by increased intensity of the ray; (2) idiosyncrasy on the part of the patient; (3) failure of the operator to observe the patient so as to determine whether the cumulative effects of preceding treatments have approached the danger point. The Court of Appeals, said the Supreme Court, concluded that the physician-defendant was confronted with the necessity of determining whether he should let his patient die of the malignant growth for which he had been treating her or continue the treatment to arrest the growth, and the Court of Appeals held that for the consequences of the exercise of his judgment in continuing the treatment after 160 antecedent treatments he was not liable. But, said the Supreme Court, while it is the physician's privilege to decide between one of two or more courses in the treatment of his patients, and while he cannot be held responsible for an erroneous exercise of his judgment, the rule is subject to the limitation that before exercising his judgment the physician must learn by proper examination the facts and circumstances on which a reasonable exercise of judgment may rest.

The defendant knew that he had administered 160 treatments. The cumulative effect of those treatments was or should have been known to him. He should have known, too, the means of ascertaining when an additional treatment would be hazardous to the patient. All physicians agreed in their testimony that the cumulative effect of the roentgen ray is ordinarily disclosed by dryness and pigmentation of the skin, thus enabling the roentgenologist to discover the danger of an additional treatment by superficial or surface symptoms. They agreed, too, that the cumulative effects of the roentgen ray are not always visible in endarteritis. *It was testified that when endarteritis, or the blood change indicative of it, is not visible on the surface, the condition may be discovered by a blood count* (sic). It was testified further that without cumulative effects visible or ascertainable on reasonable examination, the roentgen-ray dosage, if properly administered, could not produce a third-degree burn.

The physician-defendant testified that when he administered the last treatment he examined the skin, both on the back and on the abdomen, and that there was no pigmentation or dryness, but it was in evidence that endarteritis would not be apparent to a roentgenologist through an examination of the skin. Superficial symptoms, it was shown, cannot always be relied on to reveal the danger that all experts agree may result from cumulative treatment. *Hence the necessity for resort to additional methods of diagnosis, such as the blood count. The failure of the physician-defendant in this case to resort to a blood count to determine whether danger existed was not a mere error of judgment* (sic); it was the omission to do what reasonable prudence would suggest, especially where the consequence of previous treatments might lead the roentgenologist reasonably to apprehend the danger of an additional treatment causing a third-degree burn. After 160 roentgen treatments without injurious effect, the theory of idiosyncrasy on the part of the patient was incredible.

There was evidence that scarlet red was used on the patient's abdomen at some time after the last roentgen treatment. Physicians agreed that its use within a short time after the treatment would convert a first-degree burn into a third-degree burn, but they said that two weeks after the treatment the use of scarlet red would be harmless and might be beneficial. There was no evidence to show when or by whom the scarlet red was applied. Thirteen days after the treatment on May 5, a physician examined the burn and no scarlet red had been applied at that time. At his visit twenty-six days after the treatment referred to, he found that scarlet red had been applied. If scarlet red was applied, it must have been done after the danger of its use had passed.

All the explanatory evidence taken together does not destroy the weight of the inference

of negligence, arising from the doctrine of *res ipsa loquitur*. The weight of the inference, as well as the weight of the explanatory evidence, was, therefore, a matter for determination by the jury.

CASES CITED[1]

ADMISSIBILITY OF QUOTATION FROM MEDICAL BOOK

Blakeney *vs.* Alabama Power Co. (Ala.), 133 So.R. 16

Contrary to the general rule, in Alabama, by statute, historical works and books of science or art, when made by persons indifferent between the parties to an action, are *prima facie* evidence of facts of general notoriety and interest. On proof that Da Costa's "Modern Surgery" was a standard and authoritative work, certain quotations from it were introduced in evidence, among them the following: "Spitzger points out that in one case death followed a shock of 65 volts and others have survived shocks of many thousand volts." The admission in evidence of this quotation by the author of the book was objected to on the ground that it was hearsay and not shown to have come from good authority.

Such objection, said the Supreme Court of Alabama, misconceives the grounds on which the published opinions of standard authors are admitted. The fact that the author fortifies his views by quotations, or by references to the statements of others, does not render such quotations or references inadmissible, as hearsay. The author's own words are hearsay in the sense that they are unsworn declarations of a third person. His standing as a recognized authority gives sanction to his own statements and such as he may adopt from others and incorporate as part of his views.

OPINION OF MEDICAL EXPERT INVADING PROVINCE OF THE JURY

Cropper *vs.* Titanium Co., Inc. (C. C. A.) 47 Fed. R. (2d) 1038

Medical experts had examined the plaintiff in an action for damages for personal injuries. One of them testified that he made an X-ray examination of her. Based on their examination and certain facts assumed from the testimony in the record, they were asked their opinions as to the cause of plaintiff's condition. The trial court sustained objections to their testimony on the ground that the answers called for would invade the province of the jury. "But," said the United States Circuit Court of Appeals, Eighth Circuit, "if the questions propounded were such that the jury might not be capable of answering from the evidence, then it was proper that the jury should have the benefit of the opinion of an expert, even though the opinion went to the matter directly in issue. The purpose of a trial is to investigate the facts so as to ascertain the truth, and the modern tendency is to regard it as more important to get to the truth of the matter than to quibble over distinctions which are in many cases impracticable. A witness may be permitted to state a fact known to him because of his expert knowledge, even though his statement may involve a certain element of inference or may involve the ultimate fact to be determined by the jury."

[1]Reprinted by permission from the *Journal of the American Medical Association.*

EDITORIAL

LEON J. MENVILLE, M.D. . . . . *Editor*
BUNDY ALLEN, M.D. . . . *Associate Editor*

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RADIOLOGICAL PREPAREDNESS[1]

Through your gracious consideration I am privileged to open our Seventeenth Annual Session and preside over your deliberations. To thus address you as the Executive Officer of the Radiological Society of North America is a great honor. That you have made this possible for me is sincerely appreciated.

Our American Medical Association is the largest and also the most influential and democratic medical organization in the world. As such, its responsibilities are enormous. Time adds opportunities and also new responsibilities, which must be anticipated and assumed. These facts have been concisely stated by a president, who, in addressing the House of Delegates, called attention to the important position held by the American Medical Association in the social and political structure of our country.

Analogous to the American Medical Association, our association, our specialty in medicine, is enjoying the privilege of being one of the largest and most active radiological societies in the world, a distinction which has been attained within the period of sixteen years. There never has been, since the beginning of medical history, an advancement of like or similar rapidity in any branch, such as we have observed in the short period since Roentgen's discovery of the X-ray in 1895. Our organization has been primarily instrumental in promoting the development and revision of this science. We must now individually and collectively combine our energies with all other radiologists to carry on this most important and valuable branch, or specialty, in the field of medicine and surgery.

The Seventeenth Annual Meeting of the Radiological Society of North America which we are to-day opening is evidence of a progress of which we should be proud. We have accomplished this progress as a group, supporting a single cause.

During recent years the X-ray has advanced medical science—has in many fields almost revolutionized it. Men of vision, observing this rapid progress and its consequence, suggest that we may have entered only the elementary fields of possible future developments. We, as members of the Radiological Society of North America, have been participants in this development and it is our duty to prepare our organization for the obvious future progress. Individual interest and effort are no longer sufficient to attain best results: duplication of effort must be eliminated. You all know that many of us are now members of several radiological societies and subscribers to the several official journals. This means that we must attend several official meetings each year and in many other ways divide our time and efforts in the furtherance of the common cause. This is not advantageous, it seems to me. "Where there is union there is strength." Therefore, I wish to recommend at this time that a concerted effort be made to unite, or direct, the forces of the many radiological organizations of our country

[1]President's address, before the Radiological Society of North America, Annual Meeting, at St. Louis, Nov. 30–Dec. 4, 1931.

into a combined unit, to do which would transform us into the most outstanding scientific group of radiologists in the world—the American Radiological Association, Incorporated.

This American Radiological Association, Incorporated, should be so constituted that all present and future problems pertaining to our specialty could be solved in a proper manner. Inasmuch as such an amalgamation is problematic for the near future, it behooves the membership of this Society to empower a committee or a group to assume leadership and direct effort to cope with the present and anticipate future requirements.

During the past two years I have repeatedly reviewed, and reflected upon, the general rules and proceedings governing our deliberations, endeavoring to prepare for your consideration a number of constructive suggestions.

I am convinced that our duties as radiologists are far-reaching, and, further, that only a relatively small number realizes the responsibilities and demands made throughout the year on the officers of medical societies. The demands upon the time and the private funds of our executive officers are quite worthy of the consideration of this Society.

Consider for a moment, if you will, that during my tenure of office following the election in Toronto, in 1929, 1,500 pieces of mail have come to my office, requiring 5,759 replies. In this same period it has been directly and indirectly necessary to travel 24,405 miles in this country. It is also the duty of the president of this Society to attend such meetings as the International Congress of Radiology, which privilege I had and enjoyed, covering 15,748 miles through sections of eight different countries.

It is not an official duty for any officer to attend meetings other than those of this Society. However, for the welfare and advancement of our Society, it is necessary that the president make contact with as many individuals and organizations as possible. Therefore, the progressive officer will spend relatively a large sum of money in the performance of his duties.

Consequently, the Radiological Society of North America should make, at the installation of its officers for 1932, provision for a sufficient amount of money to defray the expenses necessarily incurred by its officers in the execution of their duties. In passing, I wish to state that the defraying of officers' expenses should not be limited to the Radiological Society of North America, but should be provided for in the rules governing all medical societies.

The officers of the Radiological Society of North America have functioned, and the Society has grown in size and usefulness, under the rules and regulations as laid down in our present Constitution and By-laws. This Constitution and these By-laws were, at the time of their inception, quite adequate, but since then science has revolutionized our specialty and time has brought about many other changes. Therefore, it seems to me we are confronted with a situation demanding that our Constitution and By-laws be revised to meet the changed conditions under which we are now practising our specialty.

In December, 1930, during the session in Los Angeles, a committee of five members was appointed to make a survey of the status of this organization and its government. This committee is to report its findings and submit to our governing body its recommendations and suggest remedial measures for defects, should any exist, and also recommend measures for the future expansion of the science of radiology.

A Century of Progress International Exposition will be held in Chicago in 1933 to disseminate knowledge concerning scientific achievements. The radiologists must be properly organized and prepared so that, by their united effort, they may advantageously demonstrate the progress in their specialty.

A committee of twelve, three from each of the four American societies (the American Roentgen Ray Society, the Radiological Society of North America, the Radium Society, and the American College of Radiology), has been appointed to lay plans for an American Congress of Radiology to convene in Chicago in 1933. This American Congress will unquestionably be the greatest radiological event in the world. To-night, gentlemen, let us set in motion the machinery and unite our man-power to assist this committee of twelve who must have your united support to enable them to succeed. I sincerely hope I voice the sentiment of every radiologist present when I say that it is most desirable that the efforts of this committee may be crowned with success, before the meeting of the International Exposition, in the formation of the American Radiological Association, Incorporated.

Therefore, I would suggest that we

(1) Amalgamate all American radiological and radium societies.

(2) Combine all radiological publications.

(3) Reduce the Society's operating expenses.

(4) Reduce the individual member's dues and Journal expenses.

(5) Conduct a scientific organization.

(6) Build an American Institute of Radiology.

(7) Conduct one general annual meeting and many local sectional meetings.

(8) Establish a functioning legal department.

(9) Create standards for the radiological physician.

(10) Regulate the radiological practice in hospitals.

(11) Standardize the specialty of radiology.

(12) Co-operate with the National Institute of Health.

BUNDY ALLEN, M.D.

COMMUNICATIONS

MINNESOTA RADIOLOGICAL SOCIETY

The annual meeting of the Minnesota Radiological Society was held in St. Paul on May 23, 1932. Officers for the coming year were elected as follows: *President,* Gage Clement, M.D., Duluth; *Vice-president,* Edward Schons, M.D., St. Paul; *Secretary-Treasurer,* Leo G. Rigler, M.D., Minneapolis.

The following scientific program was presented:

1. Intravenous Urography as an Aid in Diagnosis
   G. T. Nordin, M.D., Minneapolis.
2. X-ray Treatment of Inoperable Carcinoma of the Breast
   Eugene T. Leddy, M.D., Rochester.
3. Round Table Discussion of Cases for Diagnosis

Conducted by J. R. Aurelius, M.D., St. Paul.

4. Clinical-radiological Conference — Diseases of the Chest
   B. R. Kirklin, M.D., Rochester.
5. Clinical-radiological Conference — Diseases of the Stomach
   Leo G. Rigler, M.D., Minneapolis.

FLORIDA RADIOLOGICAL SOCIETY

The next meeting of the Florida Radiological Society will be held in Jacksonville, Florida, in November, 1932. The Secretary for 1932 is W. McL. Shaw, M.D., 418 St. James Bldg., Jacksonville, Florida.

ADDENDA

A letter has been received by the Editor requesting that a statement be published to the effect that the paper on Hepatosplenography, by Silvje Kadrnka, of Geneva, Switzerland, in RADIOLOGY, February, 1932, XVIII, 371, was previously published in German in *Fortschr. a. d. Geb. d. Röntgenstr., 1931, XLIV, 1, p. 9.*

The request comes from Dr. Kadrnka, who wishes to do full justice to the journal in which his paper first appeared. The omis-

sion of this statement from the first publication of the paper in English, in RADIOLOGY, was purely an oversight.

BOOK REVIEWS

TUMORS OF BONE. By CHARLES F. GESCHICKTER, M.D., Surgical Pathological Laboratory, Department of Surgery, Johns Hopkins Hospital and University, Baltimore, and MURRAY M. COPELAND, M.D., Memorial Hospital, New York City. With Forewords by DEAN LEWIS, M.D., Professor of Surgery, Johns Hopkins Hospital and University, and JOSEPH COLT BLOODGOOD, M.D., Clinical Professor of Surgery, Johns Hopkins Hospital and University, Baltimore. A volume of 709 pages and 406 illustrations. Published by the American Journal of Cancer, New York City, 1931. Price, $5.00.

The authors have presented in this book the data derived from a study of the voluminous material pertaining to the subject in the Laboratory of Surgical Pathology at Johns Hopkins Hospital and University. The subject is excellently presented and in no other place will one find such a comprehensive discussion of all phases of bone tumors.

Dean Lewis has contributed a most excellent Foreword pertaining to the interpretation of clinical findings in cases of suspected bone tumor. This is followed by a discussion of the rules of procedure for bone lesions by J. C. Bloodgood.

It is the authors' fundamental aim to present tumors of bone from the histogenetic standpoint and throughout the book the relationship between bone development and tumor formation is emphasized. It is their belief that the newgrowth observed in true bone tumors is never a simple overproduction of cells of the same type, but involves, in addition, a step in cell differentiation which is not started or caused by neoplastic processes. Instead, the histogenetic transition is a normal occurrence and the tumors occur after it has been initiated. For this reason, only those localities and age periods at which such normal histogenetic steps occur in the skeleton are capable of giving rise to true neoplasms. This gives a new importance to the skeletal and age distributions of each form of tumor, and, as is shown, these two features together constitute a most important diagnostic aid. On the basis of the above hypothesis, the authors have proposed the following classification of bone tumors:

I

Tumors related to osteogenesis

(A) Tumors derived from precartilaginous connective tissue:

1. Osteochondroma or benign exostosis
2. Chondroma or benign chondromyxoma
3. Primary chondromyxosarcoma
4. Secondary chondromyxosarcoma
5. Osteoblastic osteogenic sarcoma

(B) Tumors related to subsequent cartilaginous growth:

1. Chondroblastic sarcoma
2. Osteolytic osteogenic sarcoma
3. Bone cyst and osteitis fibrosa
4. Benign giant-cell tumor

II

Tumors of non-osseous origin

1. Primary lymphoma of bone (endothelial myeloma of Ewing)
2. Multiple myeloma
3. Metastatic carcinoma
4. Fibrosarcoma and neurogenic sarcoma

Each classification is systematically discussed as regards the clinical features, roentgenographic features, pathology, histogenesis, etiology, prognosis, and treatment.

Of particular value are the charts and tables showing age incidences, skeletal distribution, and detailed data of all cases. At the end of each chapter there is an excellent summary and bibliography. The chapter on skeletal metastasis contains a wealth of information and is exceedingly well presented.

Part III contains a chapter on therapeutic measures in lesions of bone by J. C. Bloodgood and a discussion of permanent cures in sarcoma of bone by Geschickter. The concluding chapters are devoted to differential diagnosis and juvenile lesions of bone. In the section on differential diagnosis the authors present a roentgenographic diagnosis chart which will be of considerable aid to the less experienced examiner.

The text is amply illustrated by 406 reproductions of roentgenograms and pathologic specimens, together with numerous charts, drawings, and tables. From the standpoint of

the roentgenologist the reproductions of the roentgenograms in many cases are too small. One-half or an entire page is not uncommonly devoted to a photomicrograph while the roentgenogram showing the lesions in the pelvis, chest, or a long bone is reproduced in a few square inches.

On the whole this is a most excellent treatise on the subject of bone tumors and a distinct contribution to the literature. The authors should be commended for the high quality of their work in a field into which more experienced pathologists have hesitated to tread.

THE FUNDAMENTAL PRINCIPLES OF ALVEOLO-DENTAL RADIOLOGY. (A text-book dealing with the technics of taking radiographs of the teeth and osseous tissues of the human jaws, with an analytical treatise on their interpretation as a basis of diagnosis of oral lesions.) By JOSEPH ANDREA POLLIA, M.D., Los Angeles, California, Senior attending physician and instructor of internes, Los Angeles General Hospital; Instructor in nutrition and diseases of metabolism, Dental College, University of Southern California; post-graduate lecturer on alveolo-dental radiology before numerous dental organizations. A volume of 543 pages and 774 illustrations. Published by Dental Items of Interest Publishing Company, Brooklyn, New York, 1930, Price, $8.00.

In this excellent, comprehensive presentation of the fundamental principles of alveolo-dental radiology, the author has arranged the subject in forty-two chapters, with 774 illustrations. Chapters I to III (pp. 1-25) are devoted to a discussion of roentgen-ray physics and apparatus. Chapters IV to VI (pp. 26-61) concern factors determining the resultant X-ray image and those responsible for the production of anatomical detail with a minimum of distortion. Chapters VII to IX (pp. 61-166) are devoted to an elaborate discussion of all phases of alveolo-dental radiographic technic. In this section the importance of establishing a standardized technic is emphasized. The author believes that one can never hope to achieve uniformity in the interpretation of varying radiographic densities, unless there is first a uniformity of operative technic. Chapters XIII to XVIII (pp. 166-257) describe the normal alveolo-dental structures and embody a most excellent presentation of the radiographic anatomy of these tissues. Chapters XIX to XLI (pp. 258-500) are devoted to a consideration of pathologic conditions that involve the alveolo-dental structures. Chapter XLII is concerned with the uses of radiography in preventive dentistry. Nothing is said concerning protection of the operator or patient from high tension electrical shock and the dangers of repeated or improper radiographic exposures. This omission will undoubtedly be corrected in subsequent editions.

The author is to be complimented on a masterly presentation of his subject, which, in the mind of the reviewer, constitutes the most complete book on the subject available. Doctor Pollia writes in a forceful and interesting style and has embodied within the text much practical information that comes only from years of experience.

THE DISPLACEMENT METHOD OF SINUS DIAGNOSIS AND TREATMENT. (A Practical Guide to the Use of Radiopaques in the Nasal Sinuses.) By ARTHUR W. PROETZ, A.B., M.D., Assistant Professor of Clinical Otolaryngology in the Washington University School of Medicine; Fellow of the American Laryngological Association, the American Laryngological, Rhinological, and Otological Society, the American Academy of Ophthalmology and Otolaryngology, and the American College of Surgeons. Published by Annals Publishing Company, St. Louis, Missouri, 1931. Volume of 242 pages, 145 illustrations, and 1 chart. Price, $6.00.

This small volume is a presentation of the author's Displacement Method of Sinus Diagnosis and Treatment, which was awarded the Casselberry Prize of the American Laryngological Association. The principles governing the use of radiopaque oils in sinus disease are discussed in a very complete and scientific manner.

In Chapter IX the cannulization, puncture, and displacement methods of introducing oil are compared. According to the author, dis-

placement has three distinct advantages over other methods: (1) since it depends upon gravity, the fluids themselves seek out and enter cells, no matter where they lie; (2) it accomplishes its filling without contact of instruments, and hence without trauma; (3) it results in a general filling which is necessary for the estimation of relative drainage time.

Opaque injection is not recommended as the solution of all problems of sinus diagnoses. It should be considered an adjunct and not a substitute as there are conditions in which a simple radiograph yields more and clearer information than one with radiopaques. The author does not suggest that radiography be confined to opaque methods although he does state that in his experience there is little to be derived from the simple film which cannot be deduced from the injected one when the proper technic is used. On the other hand, many things may be learned from an injected sinus which an empty one cannot reveal.

The book is adequately illustrated by numerous roentgenograms and drawings and there is an excellent discussion of the interpretation of resulting roentgenographic shadows and the various sources of error. Progressive roentgenologists will find this work of considerable interest.

CONFERENCE ON BONE DISEASES AND BONE TUMORS

Dr. Joseph C. Bloodgood has sent us the following program of the Bone Demonstration to be conducted in September at the Surgical Pathological Laboratory, Johns Hopkins Hospital.

Monday, September 19.—The morning and afternoon will be devoted to X-ray studies of the teeth and the upper and lower jaws. Oral surgeons interested in the diagnosis of lesions in the region of the jaws are especially invited, whether they belong to the medical or to the dental profession.

Tuesday, September 20.—Conference (free) of members of the medical and dental professions who bring rare tumors, or tumors difficult to diagnose.

Wednesday, Thursday, Friday, September 21, 22, 23.—Diagnostic demonstrations.

Anyone wishing to demonstrate a case should write to C. F. Geschickter, M.D., Surgical Pathological Laboratory, Johns Hopkins Hospital, Baltimore, Md.

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ABSTRACTS OF CURRENT LITERATURE

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SINUSES (DIAGNOSIS)

Accessory Sinus Infection in Suspected Pulmonary Tuberculosis. John D. Osmond. Jour. Am. Med. Assn., Dec. 12, 1931, XCVII, 1778-1781.

Chronic bronchitis, bronchial asthma, or bronchiectasis may have origin in the upper respiratory tract, especially the accessory sinuses. Roentgenograms revealing increased connective tissue branching out from each hilus region, with no parenchymal involvement, were seen in patients whose clinical symptoms suggested tuberculosis. A surprising number of sinus complications were found in series of such cases. The anatomy of the lung is reviewed and the terms used are defined. Rhinologists have received much assistance in the diagnosis of sinus disease by the making of sinus examinations before and after the injection of iodized oil.

Mullin and Ryder have shown experimentally that lymph channels drain the antra and frontal sinuses into the bronchial and mediastinal glands. Protracted flooding of the lymph channels with infectious material tends to produce a chronic peribronchitis and, if neglected, a bronchiectasis will follow. The more usual route of bronchial infection, in the author's opinion, is through the trachea and bronchial branches. Five cases typical of sinus chest infection are reviewed.

CHARLES G. SUTHERLAND, M.D.

THE SKULL (THERAPY)

Some Remarks on the Treatment of Apicitis (Petrositis), with or without Gradenigo's Syndrome. Paul Frenckner. Acta Laryngologica, 1932, XVII, 97-120.

The cases operated on for apicitis described in the literature are not numerous, nor is much said regarding the different methods of reaching the apex. The authors who have written on this subject restrict themselves to a declaration for or against a more radical operation.

The usual opinion is that even when there are pronounced Gradenigo symptoms, the case should be observed without treatment, and even when there are slight signs of meningitis, expectant treatment or operation on the mastoid is recommended in the hope that there will be spontaneous drainage or healing. Not until the meningitic symptoms become alarming is radical operation advised, *i.e.*, evacuation of the apex after complete or partial sacrifice of the labyrinth, and possibly meningeal drainage.

The only method of examination that can in life reveal the presence of a pathologic process is the X-ray. Nevertheless, X-ray diagnosis of the pars petrosa has only of late been giving good results, for which reason it is probably not possible to ascertain from the comparatively small amount of material available how extensive and of what kind the infectious changes have been (whether osteitis, osteomyelitis, or merely mucous processes in the pneumatic cells) in cases in which patients have recovered.

In two of his cases the author declares he has worked with good results in reaching the apex by a route which is probably passable in most instances, *viz.*, that through the concavity of the superior semicircular canal. Recourse to this operation is naturally greatly limited, but since, when carefully performed, it is practically no more dangerous than mastoidectomy, it should be possible to extend the indications for its use. The best treatment in every case of apicitis in which a change typical of the disease has been found by X-ray examination is to try in good time to reach the focus by this method or by a similar one.

It is thus important, with the aid of an experienced roentgenologist and with good X-ray technic, to gain exact knowledge of the changes in the apex. In case the X-ray findings are negative and the clinical suspicion of apicitis is still entertained, the examination should be repeated after a short time. It is also important to keep informed, by means of repeated lumbar punctures, of the impending possibility of meningeal complications.

W. W. WHITELOCK, Ph.D.

Roentgenotherapy in Acquired Chronic Hydrocephalus. Giovanni Paltrinieri. La Radiologia Medica, December, 1931, XVIII, 1595-1613.

Observations by the author show that, in general, patients with chronic hydrocephalus treated by him improved clinically, some of them even continuing to a cure, although at the end of the roentgen treatment they continued to manifest an endocranial pressure almost identical with that preceding the treatment. In view of this fact, he considers it probable that the mechanism of the radiologic action is to be explained not alone as regulating production of the cephalorachidian liquid, but especially as influencing the unknown cause of the disease, which seems to be an inflammatory process, of which the intercranial hypertension is only a symptom, probably connected with the existence or exaggeration of an active tonus of the meninges, according to the hypothesis of Viola.

It seems probable, furthermore, that the attenuation and disappearance of the symptoms, as the result of the roentgen treatment, are due not to the attenuation or disappearance of the mechanical factor of the hypertension but probably to the fact that the inflammatory process is weakened or eliminated. Likewise, accentuation of the branched or digitated impressions seems to be allied rather to an acute atrophy of the Sudeck type than to hypertension.

W. W. WHITELOCK, Ph.D.

THE SPINE (DIAGNOSIS)

Contribution to the Knowledge Regarding the General Occurrence of Hemangioma in the Spinal Column. C. Sandahl. Acta Chirurgica Scandinavica, Dec. 3, 1931, LXIX, 63-86.

The author describes the case, in a girl 17 years of age, of hemangioma of the twelfth dorsal vertebra and shows numerous roentgenograms of the spinal column. The process started subsequent to a trauma of the back at the age of 9, with signs of gradually increasing compressive symptoms in the spinal cord. There was evidence from roentgen examination of considerable compression of the twelfth dorsal vertebra, together with narrowing and occlusion of the spinal canal, as demonstrated by myelography, as well as structural changes in the vertebral body, characteristic of angioma. Owing to misinterpretation of the roentgenogram, the case was at first believed to be one of Kümmell's disease. Laminectomy, however, revealed a caudal neurinoma, the size of a bean, between the twelfth thoracic vertebra and first lumbar vertebra. Improvement of the nervous symptoms followed removal of the tumor.

Hemangiomas without clinical symptoms are generally encountered in persons of more advanced age, either through chance during roentgen examination or at autopsy. Cases with clinical symptoms are usually found before the ages of 20 or 25 years generally in women, with compression of the spinal cord, resulting either from deformation or compression of the vertebral body, hypertrophy of the arch, or from development of an epidural angioma. A tabulated review of 15 cases from the literature, which showed symptoms of compression, is included in the report. In none of these was an accurate clinical or roentgenologic diagnosis made. The roentgen appearance is characteristic, and a correct diagnosis should now be possible, employing the refined roentgen technic, with exclusion of scattered radiation.

W. W. Whitelock, Ph.D.

A Contribution to the Diagnosis of Syphilitic Spondylitis. Horn. Röntgenpraxis, Jan. 1, 1932, IV, 31-36.

A case of syphilitic spondylitis is reported. The eighth and ninth dorsal vertebræ were partially destroyed, a soft-tissue shadow surrounding them, and the intervertebral spaces were intact. Consideration was given to tuberculous spondylitis or newgrowths. The Wassermann reaction was positive and the symptoms of the patient disappeared rapidly after large doses of potassium iodide were administered. The roentgenologic and clinical differential diagnosis between this lesion and tuberculosis or sarcoma is considered.

H. W. Hefke, M.D.

Sagittal View of the Body of the Vertebra after Compression Injury. Otto Dyes. München. med. Wchnschr., Dec. 18, 1931, LXXVIII, 2148, 2149.

The author draws attention to a symptom, apparently not so widely known. In cases in which the body of one of the vertebræ has suffered a wedge-shaped compression through injury or disease, the antero-posterior view usually does not show this condition clearly enough, unless the arc of the vertebra is fractured. The lateral view will give much clearer evidence. However, in observing the distances from each other of the processus spinosi, one will find that the spinous process of the injured vertebra will be higher or lower than might be expected. This is due to the change in position of the vertebra, caused by the convergence of the upper and lower surfaces of its body.

Ernst A. May, M.D.

Osteo-articular and Osseous Alterations in Syringomyelia. Giovanni Balestra. La Radiologia Medica, December, 1931, XVIII, 1515-1540.

On the basis of personal observations, the author discusses the clinical and X-ray anatomic-pathologic characteristics of osteo-articular and skeletal-syringomyelic lesions.

Familiarity with the X-ray characteristics of the lesions is especially important in view of the fact that they constitute the principal manifestations of the determining disease. The osteo-arthropathies present the greatest difficulties in differentiation from dorsal tabes, since the anatomic-pathologic lesions are in substance identical. Nevertheless, the author received the impression that in the syringomyelic arthropathies the peri- and para-articular calcifications and ossifications (at least, in many cases) are not quite so marked as in tabes.

Systematic X-ray examination of the skeleton, as made by the author, may, on occasion, be extremely helpful in revealing clinically unsuspected alterations and in furnishing a valuable guide in the diagnosis of the principal disease.

Such systematic observation is opportune, not alone because it may furnish a clear perception of various changes at different stages in their development, but also because it may contribute to the study of possible pathogenetic affinities existing between different morbid osteo-articular forms of the skeleton.

W. W. Whitelock, Ph.D.

THE THYROID (THERAPY)

The Roentgen Rays and Radium in Toxic Goiter and Hyperthyroidism: Evaluation and Treatment. J. Thompson Stevens. Jour. Am. Med. Assn., Dec. 5, 1931, XCVII, 1689-1691.

For the symptom-complex known as toxic goiter,

hyperthyroidism, exophthalmic goiter, Graves' disease, Basedow's disease, etc., there is probably no treatment followed by better results than that of correctly applied roentgen or radium rays. Any foci of infection found should be removed. Contra-indications are few. A large tumor showing distinct signs of pressure is an indication for surgical removal. In some cases pre- and post-operative therapy is advantageous.

Correctly applied radiation therapy may be expected to cure from 85 to 90 per cent of cases.

C. G. SUTHERLAND, M.D.

Inviting the Discussion on Radiotherapy of Basedow's Disease. Joachim Prüfer. München. med. Wchnschr., Dec. 25, 1931, LXXVIII, 2187-2189.

This article must be read together with the one by Halberstädter on the same subject. The author connects the death of six cases of Basedow's disease with the radium treatment given to these patients. All cases had such severe symptoms that operation was absolutely contra-indicated. Some time after a radium application, the patients went into a coma, typical of this disease, and died. Six other cases, similar to those above mentioned, were radiated with very good results. During the same period in which the deaths occurred, five more cases died in coma without having been radiated.

The author suggests that these cases might have been aggravated in their condition by the application of radium. He believes that in such cases one must bear in mind the possibility of making the patient's condition worse.

ERNST A. MAY, M.D.

TUBERCULOSIS (DIAGNOSIS)

Preventive Antituberculous Vaccination by Means of the B. C. G. (Calmette-Guérin Bacillus). C. Malossi and M. Minghini. Riv. di Patol. e Clin. della Tuberculosi, November, 1931, V, 909-967.

If we admit the possibility of obtaining, by means of preventive vaccination in general, at least a strengthening of the spontaneous defensive powers of the organism as regards tuberculous infection, the problem then reduces itself to the selection of the particular method best adapted to this end. Among the innumerable methods suggested, two especially have encountered enthusiastic acceptance, as well as determined opposition, namely, those of Maragliano, by the introduction of bacilli killed by heat, and of Calmette and Guérin, by the use of living weakened bacilli.

At this late day, no doubt can exist as to the complete safety of the method of Maragliano, but in respect to that of Calmette and Guérin, by its very nature, there inevitably persists the question as to its constant, absolute and invariable harmlessness. All research, therefore, regarding the Calmette vaccine must be directed, primarily, toward two ends: determination, in the first place, of its harmlessness, and, in the second place, of its eventual value in immunization.

The authors made a detailed study of 801 infants to whom at birth the bacillus of Calmette and Guérin was administered *per os,* and for periods of from one to five years they carefully followed the cases, clinically and radiologically. The conclusions which they reach are of a somewhat indefinite and negative nature.

The bacillus, administered according to the original directions, was found to be innocuous in the case of the children healthy at the end of the period. As regards the protective quality of the vaccine against tuberculous infection, the impression was received that a certain immunization was brought about, but so weak in degree as seldom to be distinguishable from the cutaneous reactions of the various kinds of tuberculin. Despite the favorable clinical findings, it is still impossible to be certain of the specific protective value of the method.

The investigations left the question untouched regarding the harmlessness and protective efficacy of the B. C. G.

W. W. WHITELOCK, Ph.D.

Frequency and Distribution of Various Anatomopathologic Forms of Pulmonary Tuberculosis on the Basis of the Roentgenologic Picture (Statistical Study). Gino Laschi. Riv. di Patol. e Clin. della Tubercolosi, Jan. 31, 1932, VI, 51-56.

Statistics founded upon X-ray studies are open to the same criticism as those from other sources, insofar as they are based in the main on roentgenographs from institutions given over to patients suffering from the same disease. In the Institute of Radiology of the Royal University of Bologna, on the other hand, the roentgenographic material has been obtained indiscriminately from thoracic explorations of widely varying conditions, in patients of all ages, both ambulatory and bedfast. During the last five years the number of investigations was 2,906, including only such cases as were examined by both flat and stereoscopic films. It is upon these records that the author has drawn for his statistical study, but in formulating his conclusions he is careful to warn us of the merely relative value of his figures, despite the ample material on which they are based.

Both as regards the entire number of thoracic examinations and those cases with tuberculous lesions, the two sexes are represented in almost equal ratios, men and women being, seemingly, equally subject to pulmonary tuberculous infection.

The data referring to the pulmonary parenchyma show a rather high percentage (50) of bilateral

cases. This, no doubt, is due in part to the fact that many pulmonary patients defer seeking medical aid until their condition is relatively grave. Of the unilateral cases, the right lung is involved more frequently, especially in the forms localized in the apex and in the subclavicular region; further, these cases are for the greater part (73 per cent) of the cirrhotic-indurative type.

The conspicuously numerous cavities observed were in the main located in the upper third of the pulmonary field. Noteworthy also is the number of basilar cavities, at least as regards those of a tuberculous nature. Of these, 15 per cent were seen to be connected with cirrhotic-indurative processes, a fact which confirms those investigators who deny that cavities are always connected genetically with the disintegration of caseous foci, and which, further, supports the view that the cavity is not *per se* always the sign of a grave lesion, but may be associated with a relatively benign process.

The extremely high percentage of cases in which, in addition to pulmonary infiltrates, signs of pleural reactions were evident, not only emphasizes a phenomenon familiar to pathologic anatomy and to the clinic, but demonstrates likewise the noteworthy advance in roentgenologic semiotic study of the pleura, with results that accord perfectly with those furnished by other means of investigation.

W. W. WHITELOCK, Ph.D.

A Case of Panglandular Tuberculosis Associated with Appendicitis and Cholecystitis. Enrico Dotti. Riv. di Radiol. e Fisica Med., December, 1931, IV, 200-205.

Tuberculosis of the glands of the neck and bronchi, as well as of the glands of the abdomen, may assume an autonomous character, quite independent of the disease at the point of origin. Often the extension and gravity of the disease of the glands bear no relation to the pulmonary or intestinal affection, which may be very slight, altogether lacking, or already cured, while the infection passes from one group of glands to the other.

The author reports the case of a woman, 22 years of age, who entered the hospital, with disturbances in the quadrant to the right of the abdomen. Roentgenologic examination revealed the presence of a non-calculous cholecystitis, associated with chronic appendicitis, a combination described by Dieulafoy as appendiculo-cholecystitis. In addition at the roentgenologic examination, the patient was found to be suffering with tuberculosis of numerous lymphatic glands in the cervical, axillary, and inguinal regions, and also of the thorax and abdomen.

On opening the abdomen, adhesions were found between the gall bladder and the bulb of the duodenum, and the appendix was seen to be diseased. Likewise, the X-ray diagnosis was confirmed as regards the abdominal glands, which appeared numerous, in part calcified, in part caseous. Following laparotomy and appendectomy, the patient recovered *per primam.*

This case shows that the lymphatic tissue in the organism is able by vicarious action to make good any marked destruction which it may suffer, without leading to a fall below normal in the production of lymphocytes.

W. W. WHITELOCK, Ph.D.

Tuberculosis in Children. Luis Morquio. Revista Méd. Cubana, December, 1931, XLII, 1434-1443.

This article has as its objective the education of the masses of people, presenting a complete and comprehensive treatise on the latest concepts on the subject. The author calls attention to the great mortality in children, due to this malady, the various means of transmission of the organism, and the different manifestations of the disease.

In the discussion of the diagnosis the author places much emphasis on the von Pirquet test. Next to this test he considers the X-ray of most importance; the skin reaction is positive much earlier than the evident lung changes.

In discussing the treatment the author emphasizes the prophylactic treatment known as the Bacillus Calmette-Guérin. He favors this method in view of the latest reports coming from France and Italy, the rest of the treatment being supportive and consisting of measures of general hygiene.

JOSEPH MALDONADO, M.D.

Diagnostic, Clinical, and Prognostic Considerations in a Case of Cavernous Pulmonary Tuberculosis. Giuseppi Simonetti. Riv. di Patol. e Clin. della Tubercolosi, October, 1931, V, 850-858.

The author reports a case of juvenile tuberculosis, which he followed closely for many months and which illustrates some interesting phases of the disease. An early radiograph showed on the left marked diminution of the transparency of the pulmonary region, with slightly reduced diaphragmatic excursions; on the right there were blotches throughout the pulmonary space. The cutireaction was negative, with diffuse, humid râles in the left super- and subspinal regions.

There was here, evidently, a massive aërogenic invasion of tuberculous bacilli of a region hitherto immune. The ulcerative pulmonary lesions were the result of the necrosis and the consequent elimination of the portion of the lung markedly involved. Nevertheless, the general condition and the serologic examination showed a reaction prognostic of early improvement. Specific treatment proved to be best adapted to the case, which showed slow, but steady, improvement. The most recent radiographic examination indicated slight clearing of the pulmonary

condition on the left, without increase of the left subclavical cavity, and without signs of calcification. Interesting, on the other hand, is the appearance in the left apical region of the onset of a sclerotic process which had not been visible six months previously.

W. W. WHITELOCK, Ph.D.

Cervico-apical Tuberculosis Compared with Ileo-mediastinal or Central Tuberculosis. Arturo Campani and Ruggero Balli. Riv. di Patol. e Clin. della Tubercolosi, October, 1931, V, 817-833.

On the basis of clinical, radiologic, and anatomic studies, the authors discuss at length the interesting and somewhat obscure question of the relation between the cervico-apical and ileo-mediastinal or central forms of tuberculosis. Tuberculosis of the ileum, or of ileac origin, tends to develop into phthisis, insofar as the infected mass occupies a dangerous lymphatic site; tuberculosis of cervical origin tends toward slow, chronic apicitis, seldom evolving into phthisis, whether because of the relative lymphatic-cervical independence of the thorax, or because of the possibility of slow auto-vaccination of the latter, especially in cases in which there exist connections with the defences of the skin.

The general conclusions are thus formulated:

(1) The fact is constantly confirmed by clinical observations that cervical adenitis, resulting from local inflammatory conditions, whether of the skin or of the mucosa, may be directly connected with apical lesions, which in 83 per cent of the cases are on the same side as the adenitis.

(2) In the rare instances in which the adenitis is followed by calcification, such coincidence is established by radiologic observation of the contiguity of the two processes.

(3) Experiments not yet completed show that tuberculous infection in the neck tends, although slowly, to infect the corresponding lung.

(4) With scattered infection, and even with successive infection, the life of the patient whose neck is involved is longer than that of the patient with abdominal infection.

(5) Apicitis is not possible so long as cervico-lymphatic and thoracic independence is maintained; hence, it is very rare in young children, in whom those processes of periadenitis, which in the adult permit the passage of germs to the apical pleura, have not yet taken place.

(6) Cervico-apical tuberculosis presents, therefore, a picture distinctly different from ileo-mediastinal or central tuberculosis from the anatomic point of view, diverse as regards origin, course, and prognosis.

(7) The preceding facts, naturally, do not preclude either that tuberculosis of cervico-apical origin may evolve, with central-inferior exudative or disseminated processes, or that ileum- or paracentral tuberculosis, owing to lack of potential virulence or to resistance, may give rise to fibrous peribronchitic forms or to slow pleuropulmonary sclerosis. This, however, is the exception rather than the rule.

W. W. WHITELOCK, Ph.D.

TUBERCULOSIS (THERAPY)

Some Cases of Pulmonary Tuberculosis Treated by Simultaneous Bilateral Pneumothorax. Paolo S. Spizzi. Riv. di Patol. e Clin. della Tubercolosi, October, 1931, V, 840-849.

The author treated five cases of pulmonary tuberculosis with simultaneous bilateral pneumothorax. Excellent results, as shown by clinical and roentgenologic examination, were obtained in the case of patients in good general condition, with bilateral affection more diffuse on one side than on the other. In these instances the treatment was applied to the two sides, with an interval of a few days elapsing between the treatments, starting with the more seriously affected side.

No results were obtained by this method either in cases of rapidly progressive, destructive nature, or in combating the tendency of the process to become bilateral during the course of a unilateral pneumothorax.

The intervention was well tolerated. Aside from a slight thermic reaction and a temporary dyspnea, the patients suffered no inconvenience.

The only dangerous complication to be feared is, the author believes, an intervening spontaneous pneumothorax, which may result fatally, as in one of the cases reported. The method is to be regarded as one of election in certain clearly defined cases of tuberculosis.

W. W. WHITELOCK, Ph.D.

TUMORS (DIAGNOSIS)

On Intrathoracic Neurinomas. Folke Knutsson. Acta Radiologica, 1931, XII, No. 68, 388-393.

The commonest site of neurinomas is the spinal canal where they are connected by a thin pedicle to the roots of the spinal nerves. When small, they may give rise to compression of the medulla. Occasionally, they continue through the intervertebral foramen and thus assume an hour-glass contour, the constriction corresponding to the point at which they pass through the foramen.

Intrathoracic neurinomas originate from the roots of the thoracic nerves and have an hour-glass shape, with an intraspinal and a paravertebral part. The latter appears on the radiograph as a massive, well-defined, extra-pleural, more or less rounded shadow which is situated in the posterior part of the mediastinum, either paravertebrally or intercostally.

Three cases of intrathoracic neurinomas are described and illustrated, two of which were verified at operation.

M. J. GEYMAN, M.D.